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INVESTIGATIONS IN PASTURE PRODUCTION.

EXPERIMENTAL WORK AT MARTON AND RUAKURA ON VARIOUS FERTILIZER AND MANAGEMENT TREATMENTS.

A. W. HUDSON, Crop Experimentalist, Plant Research Station, Department of Agriculture.

I. INTRODUCTION.

1. Review of some British Work.

BEFORE presenting the objects of the series of investigations in pasture production now being conducted at the Marton Experimental Area and Ruakura Farm of Instruction a brief review of certain aspects of some of the important work conducted elsewhere may not be out of place, and will indicate the justification for the methods adopted in the solution of a few of New Zealand's grassland problems.

Investigations at the Welsh Plant Breeding Station at Aberystwyth (Wales), and at the Institute for the Study of Animal Nutrition at Cambridge (England) during recent years, have added materially to our knowledge regarding many aspects of the effects of various systems of management on pasture and pasture-plant production. Some of the more important findings which have an immediate bearing on farm practices may be mentioned and discussed from point of view of the New Zealand grassland farmer :—

(1) Young growth of pasture herbage is in effect a concentrated stock-food. Woodman and his co-workers(1)* state : " In respect of digestibility, well-grazed grass compares favourably with concentrates like linseed-cake, and is far superior to meadow hay of the best quality. . . . In respect of its dry matter, it may be looked on as possessing the character of a concentrate rich in digestible protein and deficient in digestible oil. It is, in effect, a ' watered ' protein concentrate." It should be noted that Woodman's remarks apply to fresh growth of grass up to three weeks of age, be it from old or from young pasture.

* Numbers in parentheses refer to particulars of literature cited at the end of this article.

(2) Woodman[2] has shown, too, that growth of two or three weeks is practically as digestible as grass one week old. Up to three weeks at least, there is no falling-off in digestibility, although a slight reduction in the amount of protein and a slight increase in fibre and nitrogen-free extractives takes place. The effect of this is to widen the nutritive ratio and make the grass a better-balanced food material, still, however, somewhat overrich in protein. Further investigations by Woodman and co-workers[3] in 1929 to 1930 on herbage cut at monthly intervals show that in the spring months the chemical composition and digestibility is not materially different from herbage cut more frequently. Under good growing-conditions during the summer digestibility of the herbage constituents is not appreciably reduced, but with dry conditions there is a lowering of the digestibility. A lowering of the amount of digestible protein occurs in summer, however. The effect of this is to make the herbage a better balanced food. During the autumn the amount of digestible protein increases again, however. The practicability of allowing grass to grow for several weeks before being eaten by stock is discussed below.

(3) At Aberystwyth[4][5], and again at Cambridge[2], it has been demonstrated that the more frequently a pasture is cut or grazed the less will be the production from it. The practical application of this fact is important, and indicates that *under a system of rotational grazing the pasture should be spelled for as long a period as possible between grazings commensurate with good utilization by the stock employed.* It must be remembered that palatability of the herbage has a definite bearing on utilization by stock, and if the spelling-period is too prolonged the resultant herbage will not be readily consumed. The effect of this can be regularly observed. The average dairying pasture, even under fair management, tends to become a mozaic of relatively long and relatively short patches of growth. When stock are turned on a pasture which has been spelled the shorter growth is usually consumed first. By the time the shorter growth is consumed the longer patches are often overrank and unpalatable, and, moreover, have become fouled; therefore, for efficient utilization it is essential that the time of stocking should be governed to a considerable extent by the development of the longer patches.

The class of stock, too, is highly important in determining the stage of growth at which a pasture should be stocked. While three weeks may prove a suitable period between grazings of a dairying pasture during the season of plentiful growth, the same pasture being stocked with sheep would have to be grazed much more frequently.

In a trial under rotational grazing with sheep being conducted at Marton it was necessary to confine the resting period of the pasture to six days during October, November, December, and January (1929–30) to ensure efficient utilization. Under a system of two days' grazing alternating with six days' spelling of each plot over twenty sheep per acre were carried for the months stated. A very considerable wastage, especially during wet weather, resulted when the period of spelling was more prolonged, and conditions became conducive to the development of foot-rot and internal parasitic disease.

Climatic conditions must play an important part in the recovery of a pasture after grazing, and whereas a six-day spell for sheep or a

three-week spell for cattle may be suitable under one set of conditions, different periods would have to be adopted under other conditions.

Perhaps the most important aspect of the investigations into the effect of the duration of spelling on the production from a pasture lies in the yield of evidence which indicates the inadvisability of the practice of more or less continuous grazing, especially in the spring, which is so common on sheep-farms in this country. The stock may be wintered on roots, but at the same time full toll is usually taken of what grass-growth there is. During the spring the stock usually have the run of all grass without any serious attempt at rotational grazing, and until late October keep growth under control. Under continuous grazing the leaves of pasture plants are constantly cut back, and these "manufacturing work-shops" of the plant are thus too understaffed to make full use of nature's raw material. Rotational grazing, with rapid grazing-off followed by spelling, gives the plants a chance to develop leaf; it takes leaf to make leaf and incidentally to strengthen the plant as a whole.

It seems obvious, therefore, that frequency of grazing must be governed by a number of factors, and the statement made above appears worthy of reiteration: "Under a system of rotational grazing the pasture should be spelled for as long a period as possible between grazings commensurate with good utilization by the stock employed."

(4) Severity of punishment or closeness of grazing of pasture has an appreciable effect on subsequent production. Stapledon([4]) has demonstrated that, in the case of cocksfoot, cutting to within 2 in. of the ground resulted in a considerably greater production than cutting as close to ground-level as practicable, the same number of cuts—seven—having been taken in each case. He states, "It would seem not improbable, therefore, that slight differences in severity of grazing would exercise an influence in a similar direction on temporary leys in their earlier stages."

It seems reasonable to suppose, and practice bears this out, that permanent pastures would be affected in the same way especially during dry weather. Stapledon([6]) states, "All the work so far conducted at the station on individual species and on simple seeds mixture (temporary leys) has shown that drastic defoliation in one year tends to decrease the yield in the next year, and that the reduction in yield is in direct proportion to the severity of such pre-treatment."

Under a system of grazing Jones and Jones([5]) found that for the early spring period a pasture under a monthly resting period *in the previous year* produced 5 per cent. more than the same pasture after fortnightly resting-periods, and nearly 30 per cent. more than after four-day resting-periods. In the second season, however, from 7th May to 14th September, the monthly rested plots, although still superior to the others, were not so to the same extent as in the first season. The monthly rested plots carried 14·3 lambs per acre for 130 days and the four-day rested plots carried 13 lambs per acre for the same period. The live-weight gains per acre showed a proportionately greater difference than the "lamb days" in both seasons, but the difference between monthly rested and four-day rested plots was less in the second year than in the first. This would indicate the possibility that under grazing conditions Stapledon's findings may not apply *to the*

same extent as under cutting and removal of herbage. It is not intended to argue that Stapledon's conclusions are incorrect, but rather to suggest the possibility that drastic defoliation by stocking may not be as harmful as drastic defoliation by mowing and removal of herbage.

When these points are considered, together with the fact that in New Zealand stock must be grazed on the pastures at all seasons of the year, it appears justifiable to again reiterate the statement made above, but with a slight addition: "Under a system of rotational grazing the pasture should be spelled for as long a period as possible between grazings commensurate with good utilization by the stock employed, *and care should be taken not to graze the pasture too closely when it can be avoided.*" Obviously, sound common-sense and a knowledge of local conditions are necessary for the most effective application of the principles embodied in good pasture-management.

2. Methods of Measurement of Manure Effect previously adopted in New Zealand.

Haying Experiments.—In New Zealand, prior to the inauguration of the present series of experiments, the effect of manures on the growth of pasture herbage has been most commonly measured by cutting the herbage at the hay stage and recording the green weight. While this method has served a very useful purpose and supplied much valuable information it has many disadvantages, some of which are as follows:—

(1) The method measures the production of herbage resulting from the period of maximum growth of grass. This period is probably the least important from point of view of increased production, for under normal conditions there is usually a superabundance of feed, as is evidenced by the number of pastures which "get away" at this time.

(2) The measurement of manure effect by weighing the hay crop tells nothing regarding those periods of the year when hay is not normally made. As indicated above, it is considered that increased production during these periods is more important than during the "hay" period.

(3) The rapidity and duration of effect of manures cannot be readily determined by the haying system.

(4) Regular haying induces botanical changes which render hayed fields considerably different from pastures which are grazed only.

Stock-grazing Experiments.—These have been carried out to some extent. As far back as 1906 Gillanders inaugurated trials at Moumahaki Experimental Farm. These were reported on in this *Journal* for August, 1910([7]). McCulloch([8]) also reported on a series of grazing trials on hill country.

A large series of trials to test the effect of applying nitrogen to dairying pastures was carried out in 1928 to 1930([9]). The chief objections to stock-grazing trials are: (*a*) They require relatively large areas of ground, which makes replication of treatments costly and difficult, and are suited only to comparison of treatments causing relatively large differences; (*b*) large numbers of stock are required; (*c*) errors associated with stock measurement are great; (*d*) unless the whole of the herbage produced is consumed the results are further subject to large errors.

3. Objects of Present Series of Investigations.

The present series of investigations was inaugurated in 1928 at the instigation of Mr. A. H. Cockayne, Director of the Plant Research Station, with the following objects in view :—

(1) It was desired to test the lawn-mower as an instrument for cutting pasture herbage for weighing, to determine the relative yields of the same pasture under different treatments.

(2) By obtaining measurements of pasture production at all seasons of the year it was considered likely that (*a*) the rapidity of effect, (*b*) the duration of effect, and (*c*) the amount of response from various fertilizer treatments could be determined for the different seasons of the year.

(3) One of the chief aims in such determinations was the finding of those manures, times and methods of application, and systems of management best suited to increasing production, particularly during periods of naturally low production.

It appeared essential that the pastures under trial should be maintained in a condition approximating as closely as possible to that of a pasture under a system of rotational grazing. This was achieved by introducing stock as explained later under the heading of " Technique adopted " (Section 5, para. 4).

The generalization made above that under a system of rotational grazing the pasture should be spelled for as long a period as possible between grazings commensurate with good utilization by the stock employed, and that care should be taken not to punish the pasture too severely, was kept steadily in view, and the stage at which cutting took place was never shorter than that which could be readily used by sheep. Usually it was between a suitable sheep-feeding stage and a cow-feeding stage when cut.

4. Points affecting Technique.

(1) *Effect of Continuous Mowing on Botanical Composition.*—Mr. Cockayne pointed out that previous experience at Winton Experimental Farm in the use of the lawn-mower as a pasture controlling agent indicated very clearly that profound changes in the botanical composition resulted from the continuous use of the mower ; consequently a technique was devised which enabled yield to be measured from cut material, but in which sheep were introduced to ensure the sward being kept under conditions of intensive rotational grazing.

White clover and " flat " weeds, such as catsear (*Hypochaeris radicata*) and rib-grass (*Plantago lanceolata*), tend to become dominant under continuous mowing, apparently due to the inability of the mower to " prune " them at all severely on account of their prostrate habit of growth, whereas more upright-growing grasses are relatively severely pruned by the mower. Under grazing white clover and such weeds as those mentioned are eaten closely by sheep, and are punished much more severely than by the mower. Woodman(1) found that white clover increased under mowing.

Palatability, too, plays an important part in determining the severity of punishment of different species. In this connection Stapledon and Davies(10) state, " Highly palatable species are prone to give

heavier yields after the mowing-machine than after sheep, while with decidedly unpalatable species the reverse is the case. The lawn-mower therefore produces entirely different effects to those occasioned by grazing with sheep, and although valuable as an experimental method of defoliation is by no means the equivalent of sheep." It should be noted that these remarks apply to a system of "mowing only" as opposed to "grazing only."

In connection with the experiment started on the Marton Area in 1928, which will be discussed later, a small area was fenced off and the whole of the herbage removed with the mower, on dates corresponding with the cutting of the experimental plots, merely to observe the effect of continuous mowing on the sward as compared with the effect of the system adopted on the experiment itself. Fig. 1 is a photograph taken in January, 1930, after seventeen months of continuous mowing. On the manured portion white clover is dominant, whereas on the unmanured portion catsear, *Agrostis* sp., and sweet vernal are the main species.

Fig. 2 shows a manured portion of the actual plots of the experiment, taken on the same date and not more than ten yards from the sward shown in Fig. 1. Catsear and rib-grass, although fairly prominent, are less in evidence than on the plots shown in Fig. 1, and grasses are more abundant.

Fig. 3 illustrates a sward which point-analysed (by Mr. E. A. Madden) in August, 1929, showed 53 points of rye-grass, 30 of white clover among small amounts of other species, and 0·9 points of catsear, per 100 points. After five months under continuous mowing (eleven cuts were taken) white clover was dominant, and catsear and rib-grass took on the growth shown on the left and right sides of the photograph respectively.

Fig. 4 shows an adjoining plot of the same pasture (the analysis at the commencement was practically identical with that stated for Fig. 3) under the system adopted for most of the work. These plots had five mowings and five grazings during the same period in which the plots in Fig. 3 were mown eleven times. Catsear, although present, took on the growth-form shown at the point of the pencil. Sheep had been eating the leaves of this plant. This photo was taken on the same day as Fig. 3, but growth was a little more advanced. Rye-grass is much more abundant and clover less abundant than on plots shown in Fig. 3.

Sufficient evidence has been advanced to indicate that, so far as its effect on the botanical composition of pasture is concerned, continuous mowing induces conditions entirely different from those occurring on a grazed pasture. Since the object of the present series of trials is to investigate the effect of different treatments on a grazed sward over a period of years, it is evident that a system of continuous mowing is unsatisfactory.

(2) *Removal of Lime, Phosphate, Potash, and Nitrogen under a System of Continuous Mowing.*—Orr([11]) gives for the average of forty-eight pastures the following as approximate percentages of the dry matter: Lime (CaO), 1·1; phosphoric anhydride, 0·75; potassic oxide, 3·0; nitrogen, 3·0. Assuming 5,000 lb. of dry matter is produced by a pasture during a period of one year (the figure is low for good pastures), the following quantities of the foregoing materials would be

FIG 1. PLOTS AT MARTON EXPERIMENTAL AREA CONTINUOUSLY MOWN AND HERBAGE REMOVED FOR SEVENTEEN MONTHS (TWENTY-FIVE MOWER CUTS).

Left—no manure; right—super, 3 cwt. per acre per annum (had received 6 cwt. since trial commenced). Compare with Fig. 2. Photo taken 13/1/30.

FIG. 2. THE SAME PASTURE AS IN FIG. 1, BUT WHICH HAD NINE MOWER CUTS AND FIFTEEN GRAZINGS BY SHEEP IN THE SAME PERIOD OF SEVENTEEN MONTHS.

Manure, 3 cwt. super per acre per annum (had received 6 cwt.). Photo taken 13/1/30.

[*Photos by H. Drake.*

FIG. 3. SWARD WHICH CONSISTED CHIEFLY OF RYE-GRASS AND WHITE CLOVER AT COMMENCEMENT OF TRIAL FIVE MONTHS PRIOR TO PHOTO BEING TAKEN.

Continuous mowing (eleven mower cuts) was carried out on this area. Compare with Fig. 4. Photo taken 13/1/30.

FIG. 4. THE SAME PASTURE AS SHOWN IN FIG. 3, UNDER A SYSTEM OF ALTERNATE MOWING AND GRAZING.

Five mowings and five grazings were taken during the same period as that in which the sward in Fig. 3 had eleven mowings. Note the catsear plant at the point of the pencil and compare it with the catsear plant in Fig. 3. Photo taken 13/1/30.

[*Photos by H. Drake.*

removed under a system of mowing and removal of the herbage : 55 lb. lime (CaO), approximately equal to 98 lb. carbonate of lime ; 37 lb. phosphoric anhydride, approximately equal to 185 lb. superphosphate (44 per cent. tricalcic phosphate) ; 150 lb. potassic oxide, approximately equal to 500 lb. 30-per-cent. potash salts ; 150 lb. nitrogen, approximately equal to 750 lb. sulphate of ammonia. The amounts will vary considerably with different pastures.

Under stock-grazing the amount returned to the pasture through the animal will vary according to whether young stock, breeding-stock, milking-stock, or mature dry stock are used. In the case of mature dry stock it is safe to say that most of the lime, phosphate, and potash, and a large proportion of nitrogen, will be returned.

It may be concluded, therefore, that the entire removal of plant-food materials, coupled with the botanical changes accompanying a system of mowing only, render it unsuitable as a means of studying production of pastures over an extended period of time if it is desired to imitate pasture-production as it would be under stock-grazing.

5. Technique adopted.

The description of the technique applies to a number of the trials under review, although it must be understood that all were not under the system of alternate mowing and grazing which is explained in paragraph (4) below. Some trials, which it was intended would be of short duration, were under the system of mowing only.

(1) *Application of Manures.*—All manures were mixed with about 750 grammes of sand per plot to aid in uniform sowing, and distributed by hand. Where " no manure " plots occurred sand alone was applied at the same rate as for manured plots.

(2) *Size of Individual Plot.*—Each plot was 36 ft. long by 4 ft. 3 in. wide, approximately equal to $\frac{1}{285}$ acre (except for Experiment 1, in which the plots were only 2 ft. 4 in. in width). This does not represent the area mowed for weighing purposes, as will be explained later in paragraph (5).

(3) *Replications of Treatments and Degree of Precision of Results.*—Usually twelve replications (*i.e.*, twelve plots each $\frac{1}{285}$ acre) were allocated to each treatment. It was considered that this would give a reasonable degree of accuracy, and that it has done so will be seen from the results of the individual experiments, in some of which certain plots are similarly treated for part of the time. The results have not been submitted to statistical examination on account of the large amount of work entailed. Further, whereas at one particular period a highly significant difference may result, at another time when a treatment is beginning to have effect, or when the effect is becoming reduced, the differences in terms of statistics would not be significant, although forming part of a well-defined trend in a graph curve of production. Generally speaking, the differences under discussion are far greater than any errors associated with their measurement, as a consideration of the data will show.

The plots were arranged in series with three or six replications of each treatment in a series, and four or two series according to the dimensions of the uniform sward available, the plots of one series being

end on to those of the adjacent series. A typical arrangement of plots was as follows (the numbers indicate different treatments) :—

1, 2, 3, 4, 5, 6, 1, &c., for 3 replications.
6, 5, 4, 3, 2, 1, 6, &c., for 3 replications.
3, 4, 5, 6, 1, 2, 3, &c., for 3 replications.
2, 1, 6, 5, 4, 3, 2, &c., for 3 replications.

Fig. 5 is a general view of one of these areas.

(4) *Maintaining the Pasture under Stock-grazing Conditions.*—In the preceding Section 4 ("Points affecting Technique"), the effects of a system of continuous mowing with removal of herbage were discussed. The method adopted to obviate these effects was as follows:—

Duplicate areas, each in itself a complete series of twelve replications of each treatment, were fenced off side by side on as uniform a block as was available. These areas will be referred to as "A" and "B," respectively. (In the case of Experiment 1 triplicate areas were fenced off.) At the commencement of the trial the ground was rolled to level out small irregularities of the surface, and the whole of both areas was cut over with a lawn-mower to remove any unconsumed patches of herbage. Both areas were then closed to allow growth to come away. When the herbage reached a general average height of about 3 in. the plots of area A were mowed. The produce was weighed as each plot was cut, and then distributed over the plot from which it was cut. A day prior to the mowing of area A, or on the morning when the mowing commenced, a mob of sheep (usually twenty to fifty) sufficiently large to eat the herbage fairly effectively by the time mowing of area A was completed, was put on to area B. As soon as the mowing of A was completed the sheep were removed from B to A, and B was then "clipped" over with the mower as used for cutting the plots for weighing. Thus the *maximum* height of any herbage on B was equal to the height to which A has been reduced by cutting for weighing purposes. The sheep removed to A invariably ate the bulk of the wilted clippings (which were spread over the ground) in a few hours, before feeding on the standing herbage on the "discarded strips." (For explanation of discard strips see following paragraph (5).) They were left on A until it was fairly well cleaned up. Both areas were then spelled again until a further 3 in. growth had occurred.

Cutting and weighing of this next growth took place on B, and grazing of A was arranged so that it was completed by the time weighing operations on B were completed. The process went on throughout the season, mowing alternating with grazing on each area, the mowing of one area coinciding with the grazing of the other. Thus each successive growth was measured, but on A and B alternately, and the growth on B took up the running at about the point to which A had been cut and *vice versa*. (Actually an error in growth-measurement did occur, and means of reducing it are discussed later in paragraph (8).) It should be noted that the only herbage removed was that which was clipped off after an area had been grazed preparatory to the closing for a growth to be mowed.

(Note: The returning of mowings to plots after weighing was adopted in the spring of 1929. Prior to that the mown herbage was removed after weighing, so that the only material returned per medium of the stock was that which was grazed off, representing the product

FIG. 5. GENERAL VIEW OF ONE OF THE EXPERIMENTS IN PROCESS OF BEING MOWN.

This particular experiment was not under the system of alternate mowing and grazing as described under "Technique adopted," para. 4, but serves to illustrate the general lay-out of the experiments. Photo taken 13/1/30.

FIG. 6. SHOWING ENDS OF PLOTS OF TWO ADJACENT SERIES "CUT OFF," LEAVING HEADLAND OF 6 FT. BETWEEN SERIES ON WHICH TO TURN MOWER IN PROCESS OF CUTTING PLOTS FOR WEIGHING.

A width of 3 ft. is cut off both ends of all plots and the material discarded, leaving a length of 30 ft. for cutting for weighing purposes. Photo taken 13/1/30.

[*Photos by H. Drake.*

of about half of the total production. The feeding of the mowed herbage in troughs on the plots was tried, and, although it proved fairly satisfactory from the point of view of getting the material eaten by stock, the ground immediately round the troughs became badly trampled and fouled. Fortunately the sheep were very obliging in showing a preference for the partly wilted herbage, even when it was spread over the ground, so this method of feeding was adopted.)

(5) *Method of Cutting and Weighing.*—A 16 in. hand-mower* with a covered grass-catcher was used. (See Fig. 7.) The method of cutting was designed so as to ensure exactly the same area being cut on all plots without the necessity for measurement. This was achieved as follows :—

Lines were stretched across all plots of each series, 3 ft. from the ends of the plots, by attaching them to permanent pegs. The wheel of the mower was then guided along the line with comparative ease, and all plots were thus trimmed off to a length of 30 ft. (the total length of plots was 36 ft.), all the grass between the lines and the ends of the plots being mown. Fig. 6 shows the process completed for one end of the plots of each of two adjacent series, where a "headland" of 6 ft. wide is mown. These headlands can be seen in Fig. 5.

Each plot was then cut by running the outside wheel of the mower parallel to the edge of the plot and about 6 in. from it. A second cut parallel to the first and a few inches from it was then made. Thus two mower cuts (= 32 in.) were taken from each plot of 51 in. in width. The strips along the edges and down the middle of the plots were rolled down to some extent by the mower wheels. These are termed the "discard" strips, which were either cut out afterwards or grazed down by sheep and were not weighed. Thus a constant length of 30 ft. and a constant width of 32 in. was cut from all plots and measurement eliminated.

Weighing : Since the spring of 1929 an ordinary balance, sensitive to 2 grammes, has been used. Two weighing receptacles of exactly the same weight are used. The weighing-apparatus is shown in Fig. 8, sheltered by a tripod covered with sacking on two sides. (Note : Prior to the spring of 1929 a spring balance which could be read to 0·05 lb. was used, but this was not sufficiently accurate for weights of less than 2 lb. or 3 lb.)

(6) *Stage of Growth at which Cutting took place and Closeness of Cutting.*—The generalization made in Section 1—namely, "under a system of rotational grazing the pasture should be spelled for as long a period as possible between grazings commensurate with good utilization by the stock employed, and care should be taken not to graze the pasture too closely"—has been kept in view in this connection.

It was not possible to imitate both sheep and cattle grazing stages of growth, so an intermediate stage was taken. The mowing of grass allowed to grow to a stage where it could still be readily consumed by milking-cows was very difficult, but growth of a greater height than what is considered ideal for sheep could be cut readily. Broadly speaking, the growth was usually about 3 in. high when cut, if weather

* A 24-in. Dennis motor-mower, donated by Imperial Chemical Industries (Aust. & N.Z.), Ltd., is now being used.

FIG. 7. PLOTS IN PROCESS OF BEING CUT.

Two mower cuts are taken from each plot for weighing, the strips between the plots being cut and discarded or grazed by stock after weighing of an area is completed. A constant area of 30 ft. (see Fig. 6) by 32 in. is cut from each plot. Photo taken 13/1/30.

FIG. 8. WEIGHING AND SAMPLING.

The covered tripod serves as a windbreak. Samples of herbage for dry-matter determinations and for chemical analysis are collected in the bags. Each paper bag has an oiled-silk bag inside it (see second bag from left). Photo taken 13/1/30

[Photos by H. Drake.

permitted. At certain stages growth was patchy, and cutting had to be governed by the growth of the longer patches. Close cutting was impossible, even if it had been desirable, as the ground was not specially prepared for cutting over with a lawn-mower. Cutting was done to within about ¾ in. to 1 in. from the ground, which would not be so close as sheep grazing, but as close or closer than cattle grazing.

(7) *Sampling of Cut Herbage for Determination of Dry Matter and Chemical Analysis.*—Owing to lack of facilities it was not possible to carry out dry-matter determinations or chemical analyses until nearly the middle of 1930, when Mr. B. W. Doak, M.Sc., was attached to the staff of the station as analytical chemist. Dry-matter determinations are now being made on all experiments (except one at Ruakura Farm of Instruction), and chemical analysis of a limited amount of material is being done by Mr. Doak.

The present series of articles will deal with green herbage as cut in as dry a condition as circumstances would allow when it is not possible to present the yields expressed as dry matter. Chemical analyses of herbage will be discussed by Mr. Doak in regard to some of the trials carried out at Marton Experimental Area.

After the product of each plot is weighed a good handful of herbage is put into a bag marked with the treatment number. In order to avoid loss of moisture from the herbage during the process of collecting, oiled-silk bags inside paper bags are used in the field (see second bag from left in Fig. 8). In this way between 500 and 1,000 grammes of green herbage are collected from the twelve plots of each treatment. Immediately cutting is finished the herbage of each treatment is thoroughly mixed, and a sample of exactly 500 grammes weighed out and railed to the Plant Research Station at Palmerston North, a distance of thirty miles. It is then dried in a gas oven preparatory to grinding and final drying.

(8) *Errors associated with Measurement of Yields, Modification of Technique, and Effect of Transference of Fertility.*—In paragraph (4) of this section it is stated that errors were associated with the measurement of actual yields in the system of alternate mowing and grazing. It was noticeable that the area from which the herbage was mown for weighing always recovered more rapidly than the one which had been grazed by sheep and then clipped over by the mower. This was due to the fact that in grazing the sheep did not graze to a uniform closeness, but actually ate parts of some species to ground-level while other species were not eaten so closely. For instance, in places white clover was stripped of its leaves to ground-level, some of the stem being eaten as well. This degree of severity of grazing could not be imitated by the mower. Consequently, apart from the effect of the more severe grazing itself in retarding recovery (see para. (4) in Section 1), the starting-point for the growth to be mown and weighed was actually below mower-cutting height. The position is represented diagrammatically in Fig. 9.

Explanation of Fig. 9: The diagonally shaded portion represents growing herbage; (*a*) indicates the condition of the herbage after grazing followed by the mower to even up unconsumed tufts and preparatory to closing the pasture for the next mowing, which will be weighed; (*b*) represents the growth of herbage following the closing after (*a*) and immediately before mowing for yield determinations (no attempt is

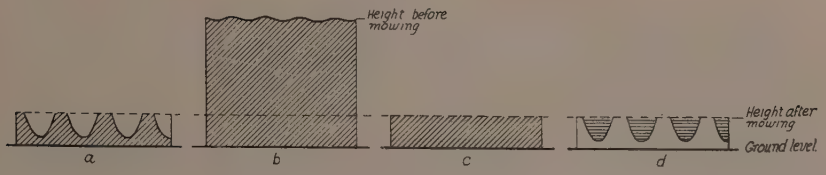


FIG. 9. GRAPHICAL REPRESENTATION OF GROWTH (DIAGONALLY SHADED) AND PORTION OF GROWTH NOT MEASURED UNDER ALTERNATE MOWING AND GRAZING (HORIZONTALLY SHADED) ORIGINALLY ADOPTED.

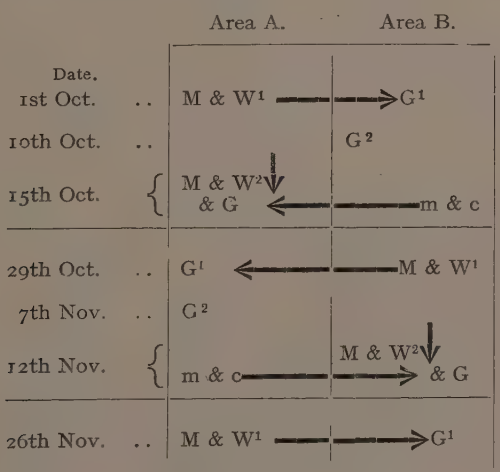
(See explanation in text.)

made to distinguish between "top" and "bottom" growth, as the illustration would become unduly complicated); (*c*) represents the herbage remaining after cutting of (*b*) with the mower. It will be noticed that although growth has taken place from a lower general average height than can be reached by the mower from stage (*a*) to stage (*b*) it has been impossible to reduce (*c*) to the point from which growth started in (*a*). The actual growth which takes place, but which cannot be weighed, is represented by the horizontally shaded lines in (*d*).

The effect of this error has been to indicate lower yields of grass than actually occurred, although it seems probable that the measurement of the relative yields of treatments has not been seriously affected. Although the experiments aim at determination of relative rather than actual yields, it is realized that reasonably true relative yields cannot be obtained without a fairly close measure of actual yields. In the spring of 1930 a modification of the alternation of mowing and grazing was adopted to try and overcome the error—to a good extent at least—and is working very satisfactorily.

Modification of Technique.

The following scheme, which is set out in tabular form with imaginary dates, has been adopted:—



(Key to symbols on next page.)

Key to Symbols.

Areas A and B represent duplicate areas of the same experiment.

M & W indicates that the herbage is mown and weighed.

G indicates that the herbage is grazed down rapidly and/or that mown herbage is eaten by sheep.

m & c indicates that the herbage is mown for clearing up growth to the same height as M & W in the adjoining area.

⟶ indicates that the mown herbage is transferred to the adjoining area to be spread over the ground and eaten by sheep.

↓ indicates that the mown herbage is spread over the plots from which it was cut, to be eaten by sheep.

Explanation of Table.

On 1st October both areas had been spelled sufficiently long to enable a growth of about 3 in. in height to have occurred. The grazing of B (G^1) precedes the mowing and weighing of A by a few hours or a day, so that grazing is practically completed by the time the mowing of the adjacent area A is completed. The herbage mown from A is then transferred to the grazed area B to be eaten by the sheep before they are removed.

The second grazing of B (G^2) shown as on 10th October takes place a few days prior to the second mowing of A (M & W^2), so that closely eaten portions have time to recover by the time A is cut, to a height which can be reached by the mower. (During periods of slow growth the time between G^2 and M & W^2 has to be considerably increased.)

After the second mowing for weighing of A (M & W^2), on 15th October, the herbage is returned to the plots from which it was cut, and the mowing for clearing up (m & c) of B takes place immediately afterwards, the mown herbage being transferred to the A area to be eaten by stock.

The area A under mowing up to 15th October is then under grazing for the period 15th October to 12th November, and the area B which has been grazed comes under mowing during the latter period. The main objectives of this modification in the system of alternate mowing and grazing are: (1) To enable the whole of the herbage to be consumed by sheep and the fæces and urine resulting to be returned to the pasture, and (2) to obtain more accurate measure of actual production by measuring the growth which takes place "between mowing and mowing" instead of "between grazing and mowing."

It should be noted that in actual practice, in order to ensure more even grazing by stock, it is found better at times to carry out three or four grazings on one area to the two mowings (M & Ws) on the other area. Each grazing can be of shorter duration, and will result in the eating of the herbage to a more uniform height without such severe punishment of some of the species. The essential points are that the grazing shown as G^1 of one area, which in reality may be the second grazing, takes place just prior to the first mowing (M & W^1) of the other area, and that the second grazing (G^2), which in reality may be the third or fourth, takes place sufficiently long before the second mowing (M & W^2) to allow the more closely eaten herbage to recover as nearly as possible to a height which can just be cut with the mower by the time the second mowing (M & W^2) of the adjoining area is carried out.

It is considered that the stock-grazing is still sufficient to ensure the botanical composition being maintained practically the same as

under a system of rotational grazing. There does not appear to be any system of measurement by mowing the conditions of which can exactly imitate those of stock grazing, but considering the errors and expense associated with experiments involving the use of stock, it seems certain that the mower under the method outlined above can be used to investigate many fundamental problems requiring a high degree of accuracy which it would be practically impossible to obtain in experiments involving the use of stock.

Transference of "Fertility."

The tranference of "fertility" from a high- to a low-yielding plot per medium of stock is recognized as being a source of error under the system of lay-out of plots adopted. Just how great an influence this may exert it is impossible to say. With plots of several yards or more in width it appears justifiable to argue that the amount of stock-grazing on any particular plot would be proportionate to the amount of herbage produced by the treatment, and that the return of "fertility" through stock would be proportionate to the amount of grazing, in which case the transference of fertility would be negligible.

With small plots this can hardly apply, for obvious reasons. Observation of unmanured ground in paddocks the greater part of which has been top-dressed regularly for some time suggests that the transference of "fertility" from high-yielding pasture to low-yielding pasture in the same field does not take place freely; or that if the distribution of the excrement does take place fairly uniformly over such a field, a plant-food such as phosphate contained in such material is much less effective on the production of a pasture than an artificial fertilizer such as superphosphate normally applied. As the results of the various investigations are presented it will be seen, too, that in some cases at least the effect of fertilizers relative to plots receiving none of the fertilizer under trial becomes better as the trial continues, so long as the applications of fertilizer are continued regularly. This applies particularly to trials in which various aspects of the use of superphosphate are being investigated. Certainly it may be due to the satisfying of the soil requirement for the fertilizer in question, but if there was any great transference of material from one plot to another or a high efficiency of the transferred material, then the non-fertilized plots should be tending to a yield more nearly approaching those of fertilized plots in the same area. Instead of this, the difference between fertilized and non-fertilized is, in some cases at least, tending to increase, and in others to maintain about the same level for corresponding periods of different seasons.

If under the system of experiment adopted transference of "fertility" is a disturbing factor, it is quite certain that the tendency must be for such conditions to react favourably toward the poorer-yielding plots and unfavourably toward the higher-yielding ones. Therefore it can be considered that at least the effect of any high-yielding treatment of a series is not exaggerated, but may be suffering from unfair handicap.

Obviously the extent to which transference of fertility, when different fertilizer treatments are enclosed in the same area, does operate must be determined, and it will be the subject of investigation at the first opportunity.

Summary.

(1) Certain aspects of the results of grassland investigations in Britain, and their bearing on the pasture-management of New Zealand farms and on the technique adopted in certain grassland investigations to be described, are discussed.

(2) A generalization is drawn from a consideration of the points brought forward. It is as follows: "Under a system of rotational grazing the pasture should be spelled for as long as possible between grazings commensurate with good utilization by the stock employed, and care should be taken not to graze the pasture too closely when it can be avoided." It is pointed out that, desirable as it may be from the point of view of production of herbage, it is not practicable to allow such a long period between grazings when sheep are being used as it is when cattle are used if good utilization is desired. Reference is made to the inadvisability of the present method of grazing sheep pastures in the spring in New Zealand. Sound common-sense and a knowledge of local conditions are necessary for the effective application of the principles embodied in good pasture-management.

(3) Previous methods of measuring grassland production by haying and grazing trials are discussed. It is pointed out that measurement of production as hay takes into account production during normally high-production periods only, and gives no information regarding low-production periods. Rapidity and duration of effect of fertilizers cannot be determined readily. Stock-grazing trials are subject to large errors, and to minimize these, large areas and large numbers of stock are required, the result being extremely costly investigations.

(4) The objects of the present series of investigations are stated. The aim is to determine the relative merits of various fertilizer treatments from the point of view of rapidity, duration, and amount of effect at different periods, with a view to finding the methods of using fertilizers best suited to increasing production, especially during periods of naturally low production.

(5) Points affecting technique are discussed. The disadvantages of "mowing only" are indicated, and photographs are shown to demonstrate these disadvantages. The amounts of lime, phosphate, potash, and nitrogen, and their equivalents in common fertilizers, removed under a system of mowing only, are given for a pasture of average chemical composition and producing 5,000 lb. of dry matter per acre per annum.

(6) The technique adopted to permit the mower to be used as a measuring agent, and at the same time allow stock to be introduced to maintain the pasture in a condition comparable to that resulting from intensive rotational grazing, from the point of view of botanical composition and return of stock excrement, is discussed. The method of collecting samples of herbage for dry-matter determinations and chemical analysis is described.

(7) Errors associated with the technique at first adopted, and the modification of the technique to reduce these errors, are discussed.

The transference of "fertility" by stock from high-yielding to low-yielding plots is discussed, and the suggestion is offered that plant-food such as phosphate in animal excrement is much less effective than phosphate in such a fertilizer as superphosphate. It is pointed

out, however, that the effect of transference of "fertility" on the results of experiments such as will be described must be the subject of investigation.

ACKNOWLEDGMENTS.

At this juncture the writer desires to acknowledge the guidance and inspiration given by his Director, Mr. A. H. Cockayne, at the initiation of the work. The field work in connection with trials at the Marton Experimental Area, which will be described, was ably carried on by Mr. T. W. Lonsdale in the 1928–29 season, and by Mr. W. B. B. Wards since that time. The latter has had a big load to carry since the work was increased in the 1929–30 season, and it is only his keen interest and disregard of official hours of work at certain seasons of the year that has enabled the programme to be maintained.

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OTAGO'S EARLY DAIRY-FACTORY HISTORY.

FRESH information has recently come into our hands concerning Otago's early dairy history, and whether or not this nullifies the pioneer claims of Edendale, Flemington, and Greytown, it certainly provides interesting matter. We have learned that Mr. George Farquhar was manager of a cheese-factory established at Pukekihi (Highcliff), Otago Peninsula, as far back as 1876. We have confirmed the fact that the date was certainly not later than 1878, and so far as we are aware there is no reason to question the accuracy of the date of 1876 which Mr. Farquhar gave. This would appear to be the first co-operative dairy factory in New Zealand, pre-dating Edendale by several years. The company shipped cheese to Adelaide in 1881, the shipments being made by a man named Darling, who ran the Adelaide Wine-shop in Dunedin. The first shipment was lost in the wreck of the "Tararua," which took place on 29th April, 1881. The factory was adjacent to the Highcliff Church, and was a brick building with a wooden lean-to. The factory ran from October to March of each year. After about ten years of operation as a cheese-factory the factory changed to buttermaking, the butter being collected from the suppliers in granular form and milled. The old Highcliff factory was equipped with revolving shelves for cheese curing, a system which is still in use in Southland to-day. The price received in the first year of operation at Highcliff was 11d., and in the second year 10d., per pound of cheese.

Harbour Cove also had a factory established not long after Pukekihi. This, we understand, was co-operative, and ran about three years.

When the foregoing information was collected Mr. Farquhar was still living at Dunedin.

—*Dairy Division.*

FAULTS FOUND IN NEW ZEALAND WOOLS.*

D. J. SIDEY, B.Ag., H.D.D., Canterbury Agricultural College.

A FEW years ago there was an outcry from a section of the Bradford wool-manufacturers concerning deterioration of New Zealand wools. This has been repeated every now and again, until some of our wool-growers have wondered how the wool has ever sold at all if it is as bad as it is reported to be. They have been perplexed further by the fact that the type of wool condemned by some Bradford buyers has realized quite often nearly as high a price per pound, and sometimes a better return per head, than has wool considered free from fault.

The reasons for this state of affairs are many-sided, but they come chiefly under two heads. The first is that the condemnation of the New Zealand wools has come chiefly from a section of the wool-merchants who are interested in a particular branch of the trade which uses long, strong, lustrous wools. The change-over from the Lincoln and Leicester to the Romney in New Zealand has meant that these men cannot obtain in this country the quantity of the class of wool they desire. Since the Romney wool is not so useful for this branch of the trade, the breed as a whole has been condemned for causing the production of bad wool. While the Romney must take a share of the blame for the deterioration of a proportion of our wool, it is obviously unfair to place all the blame on this breed. It may be pointed out here that these critics do not always recognize as such some of the good Romney wool which is grown in New Zealand, but they certainly blame the Romney for all the bad wool. While good Romney wool may not be suitable for lustre single-yarns, it is eminently suitable for other sections of the trade.

The second factor concerned is that, while a wool cannot be used in one section of the industry it may fulfil a want in another section. The result is that wool which is denounced by one buyer is sought after by another, who may be able to pay as much for this wool as the former buyer is able to pay for good wool. An example of this state of affairs is the case of a Bradford merchant who purchases annually large quantities of New Zealand Romney wool, and who at one time last year was receiving more for the tops made from the rough britch wool for the carpet trade than he was receiving for the tops from the good fleece wool. Admittedly this was only a passing phase of the market brought about by a number of causes, one being the American tariff. While such conditions as these have existed in the industry there has been little incentive to the farmer who is producing poor wool to improve his clip. However, in the future such a state of affairs is not likely to prevail to the same extent, and if the producer desires to obtain the best return for his wool he must endeavour to see that it meets within reason the manufacturers' requirements.

STRUCTURAL DIFFERENCES IN WOOL FIBRES.

Before describing the faults of New Zealand wools it may be desirable to state for the benefit of some readers the main structural

* See also article on "Wool Research in England and Scotland," in last month's *Journal*.

difference between a true wool fibre and a hairy wool fibre (more correctly termed medullated), and also a kemp, which is somewhat similar in structure. If a true wool fibre is cut across with a sharp razor and is examined, after suitable staining, under a microscope, it will be found to consist of two layers—a thin outer sheath called the cuticle and a central portion called the cortex. In the case of a hairy or kempy fibre, however, there are three layers instead of two. The third layer, which forms a pith or core inside the cortex, is called the medulla, and consists of large cells the contents of which have contracted towards the cell-walls, leaving the centre filled with air-bubbles. (Fig. 1.) In the case of a kemp this medulla may form the greater part of the fibre, with the cuticle and cortex confined to narrow enveloping sheaths. With a hairy or medullated wool fibre the medulla may vary considerably, from being like a fine pin-point in size to nearly obliterating the cortex. While a very fine medulla apparently is not harmful, a coarse medulla is definitely detrimental, but it is difficult to say where the division is between the harmful and the non-harmful conditions.

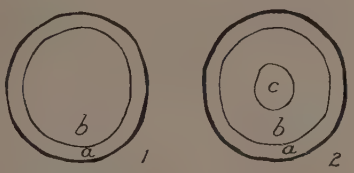

FIG. 1. DIAGRAMMATIC REPRESENTATION OF CROSS-SECTION OF (1) A TRUE WOOL FIBRE, AND (2) A MEDULLATED OR HAIRY WOOL FIBRE.

(*a*) Cuticle, (*b*) cortex, (*c*) medulla.

Medullated fibres are detrimental for two main reasons: (1) They are not so elastic nor so plastic as ordinary wool fibres, with the consequence that during manufacturing processes they may tend to break and so cause excessive wastage and uneven yarn. Because of this lack of elasticity they do not, especially at the ends, bed into the yarn as do ordinary wool fibres, with the result that they stand out from the finished material and give it an unnecessarily rough feel. (2) Although medullated fibres may dye the same colour as normal wool fibres, because of their air-filled medulla they reflect light to a greater extent and consequently appear to dye a lighter shade. In the case of high-class goods this appears to cause uneven dyeing, which naturally is not desirable, but with some other goods, such as Harris and other rough tweeds, it is useful, as it helps to give an effect which otherwise is not easy to produce.

The presence of a proportion of fibres carrying this medulla undoubtedly has been the cause of most of the Bradford criticism of New Zealand wools, and it is the outstanding fault of our crossbred wools. Badly medullated fibres can be detected by the naked eye if the wool is examined against a black background, when they stand out on account of their chalky white appearance. Fibres with a fine medulla may not be obvious by this means, but they can be detected

by the benzol test.* The medullation may be confined to an inch or two at the tip of the wool, when the wool is said to have a "thickened tip" or to be "tippy." On the other hand, it may continue down the greater length of the fibres, when they are spoken of as being hairy. At present it is not possible to enumerate all the factors which are involved in the production of this faulty type of fibre; all that can be said is that it appears, in some cases at least, to be due to a combination of several factors. A genetic factor or factors undoubtedly plays a part in the production of some of these fibres, but nutritional and climatic conditions also appear to be equally important.

By some it is thought that the tendency which primitive breeds of sheep show of producing a coarse hairy outer coat and a fine undercoat of true wool has not been bred out so completely in the modern long-woolled breeds as it has been in the fine-woolled breeds. Consequently, with any indiscriminate cross-breeding, there is a tendency for recessive characters to be intensified, and no doubt this has aided the production of that class of wool in New Zealand. It is also a fact that it is usually the coarsest and longest, and therefore the fastest-growing, fibres that are medullated. These medullated fibres have been shown to have a lower percentage of sulphur than have normal wool fibres, while Romney wool appears to be lower in sulphur than similar wools from other breeds. Therefore, if there is any tendency towards a shortage of sulphur in the blood-stream, which supplies the growing wool fibres, it will be the coarsest and fastest-growing fibres that will be the first to suffer and tend to produce medullation. From the little investigation that has been done up to the present, it would appear that New Zealand grasses are probably lower in organic sulphur than are the grasses of England, which may account in part for the production of medullated wool. This should be specially in evidence if at any time the fibres received a particular stimulus to grow at a slightly quicker rate than normal. No doubt such a stimulus is at work after shearing, when there must be an extra demand for a covering to protect the skin and to conserve body-heat, and this may account for the production of "thickened tip" in some of our wools.

Another fault of our wools (and of almost all wool, for that matter) is that the fibres are not of regular shape and size. Most wool-growers imagine that wool fibres are round, probably from analogy with similar objects, but this is not so, as the majority of the fibres may be either oval or irregular in cross-section (see Fig. 2). While some wools may show fair regularity of size of the fibres, others show marked irregularity, and such wools are difficult to spin into high-class yarn. While a perfectly round and even-size fibred wool may not be desirable for manufacturing purposes, an approximation to this form is necessary if the wool is to be put to the best economic use. This is also necessary if new and improved fabrics, capable of competing successfully with artificial silk, are to be produced. Therefore any steps the producer can take to improve matters should mean a better market for his wool. It may be mentioned here that

* "Medulla in Wool" and "A Simple Wool-testing Outfit," by B. L. Elphick, this *Journal* for February and May, 1931.

it has been observed that wools with a remarkably soft "handle" have, as a general rule, very even and nearly round fibres. Thus any tendency to improve the handle of our wools should automatically bring about improvement in the fibres from the point of view of the spinner. When selecting stud rams it is probably best to scour a sample of the wool before judging its handle, as the yolk of the wool may mask the true handle to a certain extent.

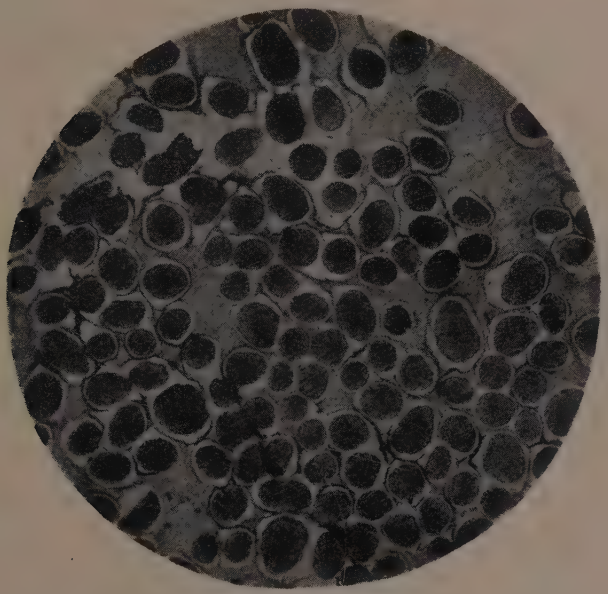

FIG. 2. PHOTOMICROGRAPH OF CROSS-SECTION OF BUNDLE OF WOOL FIBRES, SHOWING VARIATION IN SIZE AND SHAPE OF THE FIBRES.

The Factor of "Handle" in Wool.

This question of handle is one that should have more attention paid to it by all wool-producers, as there can be little doubt that improvement in this respect would lead to a more general use of wool. New Zealand wools quite often are harsher in their handle than one would expect for their quality, and steps should be taken to improve them. One of the chief reasons for the rise in popularity of artificial silk has been its remarkably soft finish, while one of the objections to wool is the prickly feeling it so often imparts to the skin. It has already been pointed out that fibre irregularity and medullated fibres have a certain bearing on the question of the handle of a wool, but there are other factors that have their parts. The shape and formation of the serrations on the surface of the wool fibre undoubtedly affect this characteristic. While the shape and formation of the serrations is partly controlled by inheritance, the amount of yolk present in the fleece also has a controlling influence. If there is any tendency towards

insufficient yolk there is not sufficient lubrication when the fibres move about over one another, with the result that the serrations are raised and intensify the harsh handle.

While dealing with this point attention may be drawn to the fact that research work has shown that if two wools of the same spinning count are taken, the wool with the greater amount of yolk is as a rule the better spinning wool, so far as laboratory examination can ascertain. In the past there has been a tendency to select away from much yolk in the fleece because such wool is penalized in price by the buyer. In doing this, however, the buyer has been to a certain extent working against his own interests, as his action has naturally influenced the production of wools that are not as good spinners as they should be. Doubtless in the future there should be a tendency to select towards a little more yolk in the fleeces of our stud sheep, especially those of the Romney type. Like all other improvements, however, there is no need to carry this to extremes.

Additional factors that influence the handle and other characters of a wool are the climatic and nutritional conditions under which it was grown, also any treatment it may have received, such as dipping, or pressing while damp. In practice the climatic conditions cannot be controlled, and one of the chief effects is produced by excessive rain, which removes the natural protective grease from the wool. This aids other factors, such as heat and the sun's rays, in bringing about chemical and physical changes in the wool fibres. The nutrition of the animal affects the handle, since it has a direct bearing on the amount of grease and suint in the fleece, and also on the type of fibre produced.

While dipping is carried out to control external parasites, some people imagine that the dip has special powers of improving the wool; but this is not strictly correct. It should be remembered that the best protective agency for the wool is its natural grease, which would be more effective in its action if dipping could be dispensed with. Incorrectly prepared or mixed dips may lead to a dip-stained wool with a harsh handle, a wool which is not only unattractive but may not scour a good bright white and may spin badly. Therefore every care should be taken during dipping operations to see that the directions supplied by the dip-manufacturers are carried out, that the correct quantity of soft water is used, and that the whole is well mixed and kept agitated. This will not only ensure that the parasites are killed, but it will lessen materially the amount of dip-stained wool.

An unusual run of several bad shearing seasons has meant that there has been an increase in the amount of wool shorn and pressed while not properly dry. When this is done a certain amount of heat is generated, which, while it may not lead to spontaneous combustion, has a deleterious effect on the wool fibres, which may assume a brownish discoloration and a hard brittle feel. Occasionally it is necessary to shear sheep that are not quite dry; but when this is done pressing should be delayed as long as possible in order that the fleeces may have every opportunity to dry. If wool which is very heavy in the grease is pressed too tightly a somewhat similar but not so drastic change appears to take place, and care should be taken to see that too great a quantity of such wool is not pressed into a bale.

Coloured Fibres scattered through the Fleece.

A fault that is said to be increasing considerably in the slipe wool from our meat-freezing works is the presence of coloured fibres scattered through the wool. This results from the marked increase in recent years of the use of Southdown sires for the fat-lamb trade. The primitive sheep, from which some of the modern breeds are descended, were frequently coloured, and remnants of this colour are still to be seen in the face and leg colourings of such breeds as the Southdown, Shropshire, and Suffolk. Where careful selection is not practised there is a tendency for these coloured fibres to appear, scattered throughout the fleece. This has happened in some cases in New Zealand owing to the popularity of the Southdown resulting in its passing into the hands of some breeders whose only object is to breed rams to get fat lambs. Some manufacturers have urged that we should use Corriedale, Dorset Horn, or Ryeland rams instead of the Southdown. Neither the Ryeland nor the Dorset Horn are so prepotent for siring early maturing and ideal-carcassed fat lambs, while the Corriedale is at the best only a dual-purpose breed, suitable for a limited class of country.

This is a case where wool and mutton interests are in conflict, and, while the wool with the brown fibres scattered through it cannot be used for white or cream goods, it is quite suitable for some other lines. For this reason it is worth nearly as much per pound as wool free from defects. The return for wool from a fat lamb is only a small part of the total return, and so the fat-lamb producer cannot afford to gain a few pence by wool-improvement and lose a few shillings owing to slower maturity and deterioration of his lamb carcass. If more attention were paid to the breeding of Southdowns free from this defect it should help the fat-lamb raiser to obtain a little extra for his lambs.

Other manufacturers complain that in some of the Hawke's Bay and Poverty Bay Romney-cross clips there is a tendency for patches of grey wool to creep in. This grey wool is probably due to an admixture of black and white fibres, and can only result from careless breeding practices. Since this class of coloured fibre can have no effect on the fat-lamb trade, every endeavour should be made to eliminate those sheep showing the fault, and care should be taken when the selection of the breeding-stock is being made.

Length of Wool in Relation to Spinning Count.

In an endeavour to obtain the greatest weight of fleece there has been a tendency on the part of some New Zealand breeders of Corriedales and fine-wooled Romneys to produce a wool which, according to the manufacturer, is too long for its spinning count. Crossbred wool—that is, wool other than Merino—is broadly classified into (1) preparing wools, which are longer than 6 in. (the length may depend to a certain extent on the count), and (2) carding wools, which are too short to go into the former group. The reason for separating the wool into these two groups is because a preparing machine has been designed to disentangle the long wool fibres and lay them parallel ready for combing, without the excessive breakage that would occur if these wools were carded. At the present time very little preparing tops of a 50's count or finer are being manufactured, with a consequence that long wools which come into this category have to be carded.

This results in excessive breakage during the carding process, a high percentage of noil to top, and uneconomic use of the wools.

The growers claim that by the extra length of wool they obtain additional weight which more than compensates for the loss in price per pound. This would seem to be a clear case where a modification of the manufacturer's machinery is called for rather than a change in the raw wool. However, the grower might make an endeavour to improve matters slightly, either by keeping the same length but growing a slightly broader-fibred wool, or else keeping the same spinning quality but growing a shorter and denser wool. As there are limits to the density of the fleece, and also to the spinning count of the wool that can be grown on any breed of sheep, the breeder's improvement is limited.

(NOTE.—Since writing the above it has come to my notice that lately there has been a demand for these long fine wools, provided they are classed separate from short wools.)

FOREIGN SUBSTANCES IN THE FLEECE.

Another defect—or, rather, defects—of New Zealand wools is the presence therein of deleterious foreign substances such as (1) jute and hemp fibres; (2) burrs and other seeds; (3) sheep-marking material that will not scour out; (4) pieces of straw, hay, or chaff; (5) pieces of skin. The jute fibres may be due to one or both of two causes: either from pieces of string and rubbish picked up in a dirty shearing-shed, or from the pack in which the wool has been baled. The former cause is easily overcome by a thorough cleaning of the shed before the shearing starts. The latter cause is not so simple to overcome, as it opens up a very wide field dealing with woolpacks in general.

For some years past there has been considerable endeavour to produce an improved type of pack which, while able to withstand all handling treatments, would be made of some fabric the fibres of which would have no harmful effect on the wool. Several attempts have been made to produce an all-wool pack, but the elasticity of the wool fibre, which is so useful for some materials, is in this case a disadvantage. It was thought that the lining of jute packs with paper might help to improve matters, but the paper has a tendency to break away from the sides of the pack during pressing. So long as jute is used, and the bale is cut open in the stores and in the sorting-rooms, there must always be a risk of some of these fibres getting into the wool. Packs made with a yarn manufactured from paper have also been tried; but these have failed owing to the material tearing rather easily, even when a thin steel wire is used to reinforce the paper yarn. From present indications it does not appear that the manufacturer will help this work by paying a higher price for wool in an improved pack, and until he does so there is no incentive for the wool-producer to pay the extra price for which these packs would be sold. The producer can help matters to a certain extent by using coloured twine for sewing his bales, and by turning the bales inside out and singeing the side which comes in contact with the wool, if this has not already been done.

Burrs from burr clover and other plant seeds in the wool can only be controlled to a limited extent, especially on rough country. Where controlled grazing and pasture management are feasible, and where

the use of a mower is possible, every endeavour should be made to control the seeding of all pasture-plants in order to prevent the seeds spoiling good wool.

Foreign matter in the wool, such as pieces of hay, straw, or chaff, may get into the wool from the food of the animal as well as from a dirty shearing-shed. In the former case it is not easily controlled, but steps should be taken to see that the sheep do not have free access to hay or straw stacks, and that all feeding-racks are so constructed that the sheep do not pull down the material on top of themselves. The fact of material getting into the wool from the shearing-shed calls for a more thorough cleaning of the shed—not only the floor, but also the walls and ceiling to remove birds' nests and wind-borne straws.

Pieces of skin in the wool are due to faulty shearing, and, while cutting the sheep should be reduced to a minimum for the sake of the animal, this is also necessary on account of the damage done to the manufacturer's machinery by small pieces of skin. Care should also be taken to see that second cuts are as few as possible, and the shearer when opening up the neck should break the wool apart, not cut it with the shears.

As was pointed out in last month's article, the question of branding-fluids has been the subject of considerable research work, which has been done in an endeavour to produce a mark that will be visible for twelve months on the fleece and yet will scour out in the mill. If the brand will not scour out—and unfortunately few of our commercial fluids will meet this requirement—then it causes endless trouble in the manufacturing processes. Not only does it affect the final material made from the branded wool, but when it occurs in hard lumps, as sometimes happens when turpentine and boiled linseed oil are used to dilute thick brands, they may break some of the finely adjusted machinery. While it cannot be claimed that the results of this research work are entirely satisfactory, still the branding-fluids made according to the formula of the Wool Industries Research Association should at least be given a limited trial to ascertain if they are suitable for some districts. If it is ever necessary to dilute a branding-fluid, then petrol or a similar volatile liquid should be used for the purpose.

Discoloured Wool.

In most clips there is usually a certain proportion of discoloured wool, which may be due to a number of causes. Dead-yolk discoloration, which is fairly well known and varies with seasonal and nutritional conditions, detracts from the appearance of the wool, but otherwise it is not harmful unless there are secondary complications. Recent research work, in fact, has shown that the colour pigment in the wool-yolk probably has a beneficial effect by protecting the wool from the effects of some of the rays of the sun. Of late years the manufacturers maintain that there has been an increase in the amount of "canary-yellow" discoloured wool in New Zealand clips. This trouble is somewhat akin to dead yolk, but is much more serious, as the wool fibres are dyed a bright yellow colour which will not scour out. The occurrence of this type of stain appears to be worst in seasons when a wet spell is followed by a warm spell, but the actual cause or causes

of the trouble has not been ascertained. There are a number of possible explanations, the most likely of which are (1) bacterial action on the wool-fat and suint, and (2) secretion by the sweat-glands of a colouring matter similar to the bile-fluids. At the present time it does not appear that it will be easy to put control measures into operation, but, as the cause of the trouble is unknown, it is rather early to speculate in this direction.

Other discolorations are caused by faulty dipping, pressing the wool while damp, and tick or ked stain. The former two have been dealt with under the heading of the handle of wool, while the latter is an indirect result of inefficient dipping. While this tick-stained wool may scour clean in many cases, the dirty appearance detracts from the wool when displayed for sale, and excessive tick infestation lowers the vitality of the sheep and the quantity and quality of the wool produced. This is another reason, therefore, for the taking of greater care during all operations connected with dipping.

General.

The faults outlined may appear to be a very formidable list, but it must be remembered that, while some few of our wools may suffer from the presence of these defects in combination, many of the best New Zealand wools are fairly free from fault. This was supported by the remarks of Sir Frederic Aykroyd and Mr. William Hunter on the collection of New Zealand stud Corriedale and Romney wools sent to the Wool Industries Research Association some eighteen months ago. After examination of the fleeces Sir Frederic Aykroyd said, " I consider that as a whole the fleeces represent a very good class of wool, and are not the class of wool of which complaint has been made." Mr. Hunter, at the Bradford Conference in June, 1930, said, " Sir Frederic Aykroyd has referred to the Romney fleeces received by the Research Association a few weeks ago. No one could complain about that wool, and if New Zealand could produce that type of wool in large quantities no complaint would be made. It was wool which could be used either for weaving or hosiery ; it was ideal wool." It was probably a slight exaggeration to say that the wool was ideal, because undoubtedly some of the fleeces referred to were not considered the best we could produce ; also it is doubtful if even the best wool produced to-day could not be improved slightly. However, the remarks quoted do show that our best wools reasonably meet the requirements of the manufacturer.

In another article the writer will endeavour to show how it should be possible to improve the faulty wools.

New Zealand Leather.—The Chairman's report at the July meeting of the Research Council included the following reference to this matter : " The fact that most of our tanneries are maintaining, and even increasing, output serves to indicate a growing confidence in the quality of New Zealand leather. Negotiations with meat interests, with a view to making use of the Empire Marketing Board's offer of financial assistance for further investigations concerning pelts, are still continuing. Evidence of the high-quality articles that can be made from first-class pelts has been received recently in the form of embossed and dyed leathers suitable for furnishings."

CONTROL OF WEEDS WITH CHLORATES.

FURTHER EXPERIMENTAL RESULTS.

J. W. DEEM, Director of the Fields Division.

IN this *Journal* for May and July, 1930, the writer dealt with the subject of the control of weeds with chlorates, and some further notes embodying experience gained during the past year may now be of interest.

After the publication of the information in 1930, and following demonstrations by officers of the Agriculture Department and by merchants, farmers became very keenly interested, and in many districts adopted the new method of treating weeds, particularly in regard to ragwort, in a very whole-hearted manner. This is evidenced by the fact that during the year ending 31st March, 1931, 417 tons of sodium chlorate was imported into New Zealand, and practically the whole of this was used. It is safe to say that another 100 tons would have been used had it been available during the period December to February.

The fact that farmers showed confidence in the new method of treatment is very gratifying, as are also the many letters of appreciation received by officers of the Department from satisfied farmers. Many farmers have stated that they were on the point of giving up dairy-farming, or going off the farm altogether, owing to the ravages of ragwort, but that now they were able to control the weed and carry on.

The demonstrations throughout the Dominion and observation of results were carried out by officers of the Live-stock Division, while the Fields Division carried out further experiments with sodium chlorate, calcium chlorate, and mixtures of the various chlorates. Some of these are definite as regards results, while others are still in the experimental stage, and will require more time before any final deductions can be arrived at.

RAGWORT.

It was pointed out in the previous articles that sodium chlorate solution at from 3 per cent. to 5 per cent. strength, if reasonably applied, gave 100 per cent. kill. A further year's work fully confirms this.

It has also been demonstrated that sodium chlorate is, if anything, more effective during showery weather than during particularly dry weather. This is an important point in many parts of New Zealand, as a farmer need not be worried by the fact that it comes on to rain in the evening after he has spent a hard day in the field spraying ragwort. Further investigation proves that as the plant reaches the flowering stage a much weaker solution than that required during the growing stage may be used. For instance, during the winter and early spring, a solution of 4 per cent. to 5 per cent. is advisable, whereas when the plants are just coming into bud, or are in the flowering stage, a 2-per-cent. solution is all that is required; in fact, when out in bloom a 1-per-cent. solution gives good control. It should be noted that when the plant is fully grown it takes more moisture to properly wet it than when it is in the seedling stage; consequently the actual amount of

sodium the plant gets may be greater in the weaker solution applied at this time than when treated in the small stage with a stronger mixture.

Although the spray, if applied heavily, has a detrimental effect on the grass with which it comes in contact adjacent to the plant, it would appear that after a time the pastures grow stronger than before. Especially is this the case with clovers, and this suggests that there is a certain amount of fertilizing ingredients in the residue of sodium chlorate. Calcium chlorate appears to give best results when the plants are in flower and warm dry weather is experienced. A heavy shower shortly after spraying with this material greatly lessens its effect. While not to be compared with sodium chlorate, calcium chlorate is still a useful agent when judiciously applied.

Probably a great many figures as to costs have been worked out by farmers and others, but they are difficult to interpret owing to the different degrees of density of the weeds treated. In an endeavour to arrive at the cost of clearing dense ragwort—that is, on land which is almost entirely covered with ragwort and where the whole area has to be sprayed—an acre was carefully measured off and the ragwort cut with a mowing machine on 16th February last. The second growth was allowed to come away and the area was sprayed with a 3-per-cent. solution of sodium chlorate on 1st April with a Davis bulk pump. Altogether 59 gallons of water and 17½ lb. of chlorate were used. The time for the whole work was seven hours, and allowing 2s. per hour for wages and 4d. per pound for the material, the cost was approximately £1 per acre. The field is now a good clean grass paddock. No doubt a fair number of seedlings will come again, and it will probably cost 3s. or 4s. to clean it up next year. The farm is a dairy-farm, and the area before spraying was useless for cows; it should now carry a cow to 2 acres readily.

A quarter of an acre adjoining, and just as badly infested with ragwort, was also cut in February and sprayed on 2nd April. A knapsack spray-pump was used, and it took two hours and 105 gallons of material to carry out the work. With the bulk sprayer better control is exercised and a finer spray can be used, with a big saving of material. It may be explained that a bulk sprayer consists of a 50-gallon oil or benzine drum fitted with a valve and air-pump to get the pressure, and 30 ft. of hose with a fine sprayer and trigger release.

In the May, 1930, *Journal*, at page 294, mention is made of a field of 5 acres of solid ragwort standing about 3 ft. high, which when sprayed took 22 lb. of sodium chlorate per acre—a total of 110 lb. for the 5 acres. This field is now carrying a clean pasture. It has been gone over three times during the past year to treat any plants that may have been missed previously and any subsequent seedlings. The material used this year was 6 lb., as against 110 lb. in the previous year. The time occupied for the three sprayings this year was four hours. One can confidently say that the ragwort on this field has now been beaten. Another badly infested field of 5 acres on the same farm, sprayed this year for the first time, cost 16s. 11d. per acre—charging material at 6d. per pound and labour at 1s. 9d. per hour.

On a Government farm under our control, which was so badly infested with ragwort that we had to purchase sheep last year to assist

in controlling the weed, 70 acres were sprayed. The cost varied from 3s. to 13s. per acre, according to the density of the ragwort. The maximum amount of sodium chlorate used per acre was 20 lb., and this was on land classed as under solid ragwort.

A great number of farmers' experiences could be given. The following, taken at random, are quoted as typical cases :—

A dairy-farmer in Taranaki, whose place was so badly infested that he had decided to give up dairying, and who had spent £100 in pulling ragwort the previous year, decided to give sodium chlorate a trial. He sprayed the whole farm in seventy days at a cost for material of £23 15s. This, plus seventy days' wages at 14s. per day, works out at £72 15s., as against £100 for pulling, and to use the farmer's own words, "I have now a clean farm and can go on dairying."

Mr. F. A. N. Clausen, No. 1 Line, Palmerston North, advises as follows regarding the use of chlorate for destruction of ragwort : "On the area treated with chlorate it is now, at the end of July, almost, if not completely, impossible to find a surviving ragwort plant. What it means to me is made clear from the fact that for some years it has been necessary to cut back the ragwort on the area of 4 to 5 acres four times each season. Each occasion of cutting called for a week's labour covering the time available between morning and evening milking, and to make matters worse this labour had to be given when other farm work called for attention. This four weeks' labour is now not necessary."

Mr. J. D. Galvin, Pohangina, advises that on his farm until last year there were acres of land which carried only ragwort. The herbage might be described as a mass of ragwort in which a few struggling grass and clover plants could be found on careful investigation. It was necessary to cut this large area three times each year, and this meant an immense amount of labour. Last year over ½ ton of sodium chlorate was used in spraying, almost the whole area being treated with a 4-per-cent. solution. Mr. Galvin says emphatically he is more than satisfied with the results, which are better than he thought possible. What was a mass of ragwort is now carrying a good sole of grass, in which occur a few stray ragwort plants that escaped notice when the spraying was being done. He estimates that a week's spraying this year will be sufficient to deal with the ragwort remaining. He considers that the land will most likely be completely free from ragwort after this year's spraying.

Blackberry.

Further trials to control this weed have not been altogether satisfactory. In some cases a good kill has been recorded, whereas in others, which were treated in exactly the same way, the results have been poor. The best results have been obtained with solutions of from 5 per cent. to 10 per cent. ; stronger solutions have not been so good. The most effective time to spray appears to be when the plants are in full flower or fruiting, mainly from Christmas onwards. Treated at this period the plants receive a great shock, and if any new growth is sprayed soon after it makes its appearance, good results are usually obtained. The position is that further work will have to be carried out before we can make any definite recommendation as to the value of sodium chlorate for the control of blackberry.

Californian Thistle.

Further experiments confirm both New Zealand and American experiences that autumn is the best time to treat this plant—from the full flowering stage onwards. About 2 cwt. of the material per acre spread over the affected area gives a high percentage of kills. This is expensive, and we find that two to three sprayings in the autumn, with a 5-per-cent. to 10-per-cent. solution, have given quite good results. Kills of fully 80 per cent. of the plants have been obtained, and if followed up the next season a complete kill is procured. However, it would appear that in general the treatment of Californian thistle with chlorate is too expensive, although where small patches exist on an otherwise clean farm it can be recommended. Several acres of thistles were sprayed during last summer on two Taranaki dairy-farms, and a few days after spraying the herd had access to the areas. The cows promptly ate all the thistle-tops and appeared to relish them—in fact, it was difficult to drive them away from the sprayed areas—but although large quantities were consumed the stock did not show any bad effects.

GORSE-SPRAYING EXPERIMENT.

In foreground, gorse sprayed with a 5-per-cent. solution of sodium chlorate in September, 1930, and surviving plants again sprayed with a 3-per-cent. solution in January, 1931. In background, gorse not sprayed.

Gorse.

Both sodium and calcium chlorate have been tried for the control of gorse. An area covered with gorse from 1 ft. to 6 ft. in height was chosen, and spraying was carried out in September, 1930, with 5 per cent., 10 per cent., 15 per cent., and 20 per cent. solutions of sodium chlorate. The stronger solution showed up best for the first few weeks, but it was soon apparent that the weaker solutions were giving best

results. An examination in January, 1931, showed considerable recovery in the strong-solution areas, but where 5 per cent. was used there were only a few plants showing recovery. The new growth was again sprayed at the end of January with a 3-per-cent. solution, and at the present time the land is practically free from gorse, only an odd spindly plant can now be found. The calcium chlorate did not prove effective.

Other tests have also shown that a 5-per-cent. solution is more effective than stronger sprays, and it is, of course, much cheaper. Further experiments to test the economics of gorse control with sodium chlorate are now being undertaken.

St. John's Wort.

Further trials have been carried out in the control of this plant with sodium chlorate, both in the spring and autumn. Spraying in the spring resulted in poor control, only 30 per cent. to 40 per cent. of the plants being killed, whereas spraying when the plants were in bloom resulted in almost 100 per cent. of kills. This confirms the New South Wales results, where a 10 per cent. solution of sodium chlorate sprayed on the plants when in full bloom gave a 100 per cent. kill.

Other Weeds.

Field daisy.—One spraying with a 5-per-cent. solution of sodium chlorate is very effective, giving an almost complete kill.

Broom and fennel.—Experiments to control these plants with solutions ranging from 5 per cent. to 20 per cent. have given poor results. The plants are burnt a little, but soon recover.

Periwinkle.—A 5-per-cent. solution of sodium chlorate carefully applied to this plant gives from 95 per cent. to 98 per cent. of kills.

Pennyroyal.—Further trials on this weed with a 4-per-cent. solution have given 100 per cent. kills, thus confirming the previous year's experience.

Chlorate Preparations tested.

"Atlacide": This is an American preparation consisting of 45·5 per cent. chloric acid, equal to 56·4 per cent. calcium chlorate, and a mixture of sodium, magnesium, and calcium chlorates of 31·8 per cent., the balance of 11·7 per cent. being made up of inert matter and including water. This preparation has been thoroughly tested and gives a 95-per-cent. efficiency on ragwort, against a 100-per-cent. efficiency with sodium chlorate. Atlacide has the great advantage that it will not burn, consequently the fire risk is eliminated. Its disadvantages are that it costs, landed in New Zealand, about £6 per ton more than sodium chlorate, and when exposed to the air it is very hydroscopic and will liquefy in a few hours; consequently it is not so easily handled. However, where persons are afraid of the fire risk it can be recommended with confidence.

"Occysol": This is made in France, and consists of a mixture of sodium chlorate, sodium fluosilicate, and sodium chloride. A small quantity has been tried on ragwort, and at the same strength it gave a 98-per-cent. efficiency as against 100 per cent. with sodium chlorate.

It will not burn, and indications are that it can be landed in New Zealand at the same price as sodium chlorate. Further supplies have been received, and it will be thoroughly tested during the coming season. If it stands up to the test, as recent results indicate, it should largely replace sodium chlorate owing to its freedom from fire risk. The manufacturers claim that it has almost entirely taken the place of sodium chlorate in France.

General.

The experiments with some weeds have not been very decisive, and further work will have to be carried out before we can give definite advice in regard to them. However, the time appears opportune to make known to persons interested just what our experiences have been. No doubt many interested persons will have been doing some experimental work on their own account, and we would greatly appreciate their results should they care to send them along.

There have been a few cases of burning with sodium chlorate, two or three people being so badly injured that they had to go into hospital. These accidents have generally occurred through getting clothes saturated with the spraying solutions, allowing them to dry, and then coming into contact with an exposed flame. One case of fire through friction of the material on a floor is reported from the East Coast district of the North Island.

Some farmers have tried mixing a few pounds of sodium chlorate—say, 8 lb. to 10 lb. with 2 cwt. of carbonate of lime, and applying it broadcast to land infested with ragwort and other soft weeds. This has given a certain amount of control where the sodium has actually come in contact with the weeds. However, there does not appear to be enough sodium in the mixture to reach all weed plants, and if much more was used it would become very expensive and also for a time prove detrimental to the pastures. It is suggested that when opportunity offers farmers should treat a small area in this way and note results. The Department has a few small experiments on these lines under observation, and we hope to extend them this summer.

Experiences in New Zealand as well as in other countries show definitely that sodium chlorate can be used as a spray at too great a strength to give good results. When used at over strength the sprayed plants appear to get hardened by burning, and this prevents the sap taking up the sodium and conveying it to the roots. All our best results have been obtained with solutions ranging between 3 per cent. and 10 per cent.—from 3 per cent. to 6 per cent. for preference.

Phormium Investigations.—At a meeting of the Research Council last month the Chairman made the following reference to this subject: "Although, on account of lack of funds, research upon phormium problems has been retarded, the information already available is being applied to the factors relating to the proposed use of phormium for fabrics. The plantations of selected and specially bred plants are being satisfactorily maintained. With the prospect of an early commencement of manufacture of phormium fibre into fabric, demanding large supplies of raw material at lowest cost, the information already gained from research will be valuable in furthering any extension of planting that may be necessary. The Prime Minister has approved of arrangements being made for full-scale trials of promising new methods of stripping. The information now available as to suitable strains and suitable soil-types places phormium-planting on a better basis."

FIREBLIGHT AND ITS CONTROL.

G. H. CUNNINGHAM, Mycologist, Plant Research Station, Department of Agriculture, Palmerston North.

FIREBLIGHT made it appearance in New Zealand in 1919, when in December of that year it was found in an orchard at Te Papa, near Auckland. Its manner of introduction into the Dominion is unknown, although there is some evidence of its having been brought from North America with nursery stock. That the disease came from that country is fairly certain, since, so far as is known, it appears to be confined to the North American Continent and New Zealand; for it now appears that the records of its occurrence in Japan and Europe are not well authenticated.

DISTRIBUTION WITHIN NEW ZEALAND.

Following its appearance at Te Papa in December, 1919, fireblight was found by the writer in January, 1920, to be present in orchards at Hamilton, Cambridge, Te Awamutu, Tauranga, and Opotiki; and by the end of 1921 the disease had spread through the greater part of Auckland Province, from Paparoa in the north to Te Awamutu in the south, and eastward through Te Aroha, Thames, and Tauranga, to Opotiki. In fact, wherever pome-fruit orchards and hawthorn hedges formed a continuous area around the initial points of infection, the disease had spread throughout that area. In 1922 fireblight was found in orchards near Wanganui, and late in that season in the Wairarapa (Cunningham, 1925).

Then followed a period of comparative quiescence, until in 1926 the disease again became epiphytotic, further outbreaks occurring at Havelock North (Hawke's Bay) and Palmerston North (Manawatu). In 1927 it was found to be widely spread through Hawke's Bay, Wanganui, Manawatu, Wairarapa, and Hutt Valley districts, spread again being general where hawthorn and pome-fruit orchards formed continuous zones.

In 1929 fireblight was isolated from two widely separated regions in the South Island, in one case from pear trees in Christchurch, in the other from hawthorn at Kaikoura; and was also found at Gisborne, a district which hitherto had been the only fruitgrowing area of any size in the North Island to escape infection. The accompanying map (Fig. 1) shows areas in which the disease is now known to occur, and gives the approximate dates on which outbreaks were discovered in each.

The manner of its spread into new localities is unknown, for, following the outbreak in Auckland Province, regulations were enforced prohibiting the removal of infected material from this to other fruit-growing centres, and nursery stock was not allowed to be sent from the North to the South Island. Even queen bees had to undergo a period of quarantine before they were permitted to enter the South Island from the North. Yet despite these precautions the disease has spread to all commercial orchard areas of the North Island, and has been introduced into one large region of the South.

FIG. 1. MAP SHOWING FIREBLIGHT DISTRIBUTION IN NEW ZEALAND.

The black areas show distribution up to 1925. Subsequent infections are indicated by the year of isolation. Orchard areas in which the disease is present are indicated by the following numerals: 1, North Auckland; 2, Waikato; 3, Thames; 4, Tauranga; 5, Opotiki; 6, Wanganui; 7, Greytown; 8, Hawke's Bay; 9, Gisborne; 10, Hutt Valley; 11, Kaikoura; 12, Christchurch.

[*After Reid (1930).*

HOST-RANGE.

In New Zealand the fireblight bacterium has been isolated from apple, hawthorn, medlar, pear, quince (Waters, 1922), loquat, and *Pyracantha angustifolia* (Reid, 1930). It is, as a rule, troublesome only on pear and hawthorn, seldom causing serious injury on apple or the other hosts enumerated.

In North America fireblight has a much greater host-range, since it has been recorded additionally upon species of *Crataegus*, wild and cultivated strawberry, *Amalanchier canadensis*, apricot, cherry, plum, rose, mountain-ash (*Sorbus*), and *Spiraea* (Rosen and Groves, 1928). But several of these have not been found infected under natural conditions. Reid (1930) failed to secure infection on plum, cherry, or rose under artificial conditions, so it is reasonably safe to assume

that in this country the disease is scarcely likely to prove troublesome in stone-fruit orchards.

Appearance on the Hosts.

This disease infects blossoms, fruits, shoots, and branches. The first signs of infection occur as a rule at blossoming-time, when the flowers suddenly wilt and turn brown. This condition, which has been termed "blossom-blight," is in certain seasons a conspicuous feature, especially on apple trees. Blossom infection is usually followed by wilt of the leaves of the blossom spur, since the bacteria pass down the flower pedicel, through this structure, to the lateral or branch to which it is attached. If the blossom happens to be attached to a lateral, the disease usually girdles and causes its death. On such the leaves as a rule do not fall, but persist, turn brown, and, if infections are at all numerous, give to the tree its characteristic appearance of having been scorched by fire—hence the name "fire-blight."

Should the blossoms be situated on branches, infection of these may occur, resulting in the formation of cankers, and frequently in their death. Cankers produced in this manner are characteristic in that the bark is darker in colour than the surrounding healthy tissue, and although the surface becomes slightly sunken it is not broken into areas by crevices, as with cankers produced by certain fungi. The canker becomes delimited finally from the healthy tissues by a clearly defined crevice (Fig. 2). Reid has described (1930) the microscopic appearance of such cankers in sufficient detail to enable them to be recognized readily. Sometimes the organism continues to extend down the branch or limb, forming cankers that may extend for several feet. In such cases, which appear only upon hawthorn and pear, the limb is usually killed outright and rendered conspicuous on this account (Fig. 3).

In extreme cases the disease may continue to spread until the main stem is reached and girdled, when death of the entire tree follows. This last condition is rare, and has been encountered only in pear orchards destroyed in the first few seasons of the appearance of the disease in New Zealand.

On fruits the disease produces a soft-rot not unlike those produced by certain fungi, but differing in that numerous globules of bacterial exudate (the so-called "ooze") are usually present scattered over the surface (Fig. 4). This condition has been termed "fruit-blight."

In North America the disease often attacks and destroys the roots, a phase of infection which has not been experienced in this country.

Economic Importance.

When fireblight appeared in New Zealand it destroyed in a single season many acres of pear trees, and threatened to become a menace to the fruit industry. But within two or three seasons after this initial outbreak it had ceased to cause more damage than the death of occasional branches of pear trees, and the destruction of a proportion of blossom spurs on apples and pears. When the disease appeared in epiphytotic form in Wanganui, Hawke's Bay, Manawatu, and

FIG. 2. CANKER ON PEAR BRANCH.

Point of entry is indicated by the stump of the shoot down which the organism progressed.

FIG. 3. CANKER ON MAIN LIMB OF PEAR TREE.

The entire branch above the white band has been killed by the pathogen.

[*Photos by E. B. Levy.*

Wairarapa districts in 1927 it likewise appeared at first in virulent form, but after a season or so appeared to become relatively of slight economic importance.

As a result, fireblight is to-day regarded as a serious disease only by growers in those localities in which it has not made its appearance.

Under normal conditions the disease takes a small annual toll of blossoms, and to a lesser extent kills occasional branches. In extreme cases it may cause the death of pear trees. The damage to blossoms seldom assumes serious form, as the proportion destroyed is usually less than the fruits which would be removed in the course of thinning operations. From an orchardist's point of view, the chief drawbacks of the disease are that its presence necessitates additional work in surveying the orchard against its presence, in the labour of removing or treating infected material, and principally in the necessity of having to pay the fireblight tax.

The presence of fireblight in New Zealand has led to the Australian authorities placing an embargo against the importation of nursery stock from the Dominion, a matter which scarcely affects the orchardist, though a handicap to the nurseryman.

FIG. 4. FIREBLIGHT ON PEAR FRUIT.

Showing bacterial exudate on Keiffer's Hybrid variety, developed five days after inoculation.

[*Photo by H. Drake.*

Life-history of the Fireblight Organism.

Fireblight, a bacterial disease, is caused by *Bacillus amylovorus* (Burr.) Trev. It was the first example known of a disease of plants being due to this class of organism. The organism was first isolated in New Zealand by Waters (1921) from pear wood sent in from Te Papa, and later from apple, hawthorn, pear, and medlar specimens sent from various localities in Auckland Province. The bacterium obtained was compared with cultures of fireblight obtained from North America, and was found to be, for all practical purposes, identical, thus showing that the disease in New Zealand and North America termed fireblight is due to the same cause. Work of isolation, inoculation, and verification from the hosts recorded has been conducted many times subsequently by Waters, and by Reid (1930). The latter has given

technical details of the New Zealand strain, showing that with minor differences it agrees very closely with the American form of *Bacillus amylovorus*, which should convince the most sceptical that the fire-blight disease of this country is the same as that known to North American workers.

The bacterium overwinters in cankers formed on large branches of apple, pear, and hawthorn. Here it remains quiescent during the winter months, and in early spring appears upon the surface of the canker, embedded in the exudate described previously. This is at first fluid, but later dries to a stiff resinous mass, amber in colour. In the presence of moisture the exudate may again assume a liquid form. The bacteria remain in a viable condition within this dried exudate for a considerable time—as long as from nine months (Waters, 1922) to twelve months (Thomas, 1930). The exudate appears at a time coinciding with blossoming of apple, pear, and hawthorn, and appears to attract insects, which carry away with them, attached to various parts of their bodies and even in their mouth parts, large numbers of viable bacteria. Should such insects visit blossoms they may leave in the calices organisms which are capable of reproducing in the nectar contained therein (Gossard and Walton, 1922). These may then penetrate into the tissues of the calyx, and thence to the lateral or branch via the blossom pedicel.

Many species of insects have been shown to be carriers of fireblight, among which are honey-bees, aphides, leaf-hoppers, borers, and sucking insects (Rand and Pierce, 1920).

Fireblight may also infect young shoots directly, so that infection of a tree may occur other than through the blossoms. Infections of this nature may arise through injuries induced by sucking insects, since these may carry the organism in their mouth parts. Once the organism has become established in the woody parts of a tree, it may continue to spread for some time and produce exudate, or it may form a small local lesion and then cease to develop further. Thus "ooze" may be produced at intervals through the greater part of the growing-season, and as a result spread of the disease may be continuous over this period.

This cycle of infection indicates that the disease is spread by insects which, visiting cankers producing bacterial exudate, may carry with them quantities of bacteria to blossoms or shoots. Cankers remaining in a quiescent state through the winter months therefore play an important part in the life-cycle of this disease, since it is by their agency that fireblight is perpetuated from one season to the next. But these hold-over cankers are not the only potential source of infection, for Rosen (1930) secured viable fireblight organisms in the early spring from a beehive (where they had overwintered), and bees from this hive were also found to be carrying the organism. Thomas (1930) found that when bacterial exudate from pear shoots was applied to wood, wax, and honey in a frame placed in a covered dish in the dark, the organism remained viable on the wood for twenty days, in the wax for fifty-five days, and in the honey for fifteen days. It is quite possible, therefore, that blossom infection may occur as a result of visits by insects from infected beehives.

Control Measures.

As fireblight overwinters in cankers on apple, pear, and hawthorn, and as it is carried from these to blossoms or shoots by insects, it is evident that removal of the cankers would eliminate the disease. But the experience of the past ten years has shown that such a practice is by no means as simple as it would at first sight appear. Detection of cankers in commercial orchards is in itself a difficult task, and unless all are destroyed there is every probability that the work will be rendered of little value by cankers which have been overlooked. The position is made more difficult by the fact that hawthorn has proved a susceptible host and one of the principal sources of the hold-over canker; consequently, in those regions where this plant is used as a shelter hedge, the elimination of fireblight by cutting out hold-over cankers becomes a practical impossibility. General eradication of these hedges is not feasible, partly because of the prohibitive cost, but chiefly because in many localities they are too valuable as shelter-belts to permit of their being destroyed.

This difficulty has been met by the passing of the Fireblight Act of 1922, empowering the Governor-General to declare any specified district to be a commercial fruitgrowing district, and to make regulations for the trimming or cutting-down in the manner and at the times specified of all hawthorn growing within the declared district or any part thereof. Within the meaning of this Act, the following areas have been declared to be commercial fruitgrowing districts: Port Albert, Warkworth, Waitemata, Albany, Te Kauwhata, Thames, Hawke's Bay, Greytown, Waimea, Marlborough, Rangiora, Christchurch, and Otago.

At present the Act has been enforced only in those commercial areas where fireblight control is practised. Its use has made possible the removal of hawthorn hedges in the vicinity of commercial orchards, where they have little, if any, economic value, and the abandonment of fireblight eradication in those non-commercial regions (such as the Waikato) where these hedges are numerous and provide valuable shelter-belts for the dairy-farmer.

The practice now adopted in districts in which the disease has appeared is for the Orchard Instructor to work in co-operation with fireblight committees established by statute, whose members generally assist in the organization of control work in their respective districts. During the growing-season cutting out of small cankers and sterilization of larger ones is rigorously practised. The result has been that in most commercial orchard areas the disease is seldom now troublesome, and rarely appears in epiphytotic form.

Cutting out is practised during the summer months, especially in the earlier part of the season, since this has the advantages of preventing spread of the disease to other parts of the tree and to other trees, and induces rapid callus-formation and formation of wound gum, thus preventing the entry of silver-leaf and other wound parasites. Cankers are, as a rule, more readily detected during this period, since the dead leaves present on killed shoots indicate their position.

The method found most effective has been to cut out completely all infected laterals, fruit spurs, or small branches, the cut being made some little distance below the visible point of infection. On larger branches and limbs the canker may be trimmed and sterilized in

such a manner that the limb may be saved (unless it has been killed by the organism) and the wound ultimately callus over. To this end, with a sharp knife, chisel, or gouge remove discoloured wood to a depth of at least half an inch below the surface. Trim the wound to an elliptical or fusiform shape, the long axis being parallel with the branch, and thus facilitate callus-formation.

Sterilize the wound by swabbing with a sponge or brush dipped in the following solution: Mercuric chloride, 1 gramme; hydrochloric acid, concentrated, 15 c.c.; water, 1,000 c.c. This may be made up in stock solution by adding 20 grammes of mercuric chloride to 300 c.c. of commercial concentrated hydrochloric acid. To use, dilute one part of this stock solution with sixty parts of water. Keep in a glass container (Cunningham, 1925).

After sterilization, as soon as the wound has dried out, paint it with coal-tar. Examine the treated canker in a month or so, and if the disease appears to be spreading, then the cutting, sterilizing, and painting operations must be repeated.

This procedure is obviously impossible to apply in other than commercial or private orchards, owing to the labour involved. Therefore when cankers are encountered in hawthorn hedges the simplest method is to cut down the hedge and destroy by fire. This has the disadvantage that plants throw fresh shoots which readily become infected; but this drawback can be overcome by spraying the developing shoots with a weed-killer. The two most effective on the market are sodium chlorate, at the rate of 1 lb. to 10 gallons of water; and arsenic pentoxide, at 1 lb. to 40–50 gallons of water. The former is not only more effective, but is not poisonous to stock. The most effective method of dealing with hawthorn, however, is to pull the plants bodily out of the ground with a tractor or horse team.

During pruning and cutting-out operations pruning-tools should be sterilized, otherwise they may carry the disease to healthy plants. This operation may be effected by swabbing the tools with a solution of formalin at a strength of one part to fifty parts of water.

The question of resistant varieties is frequently raised, but experience during the past ten years has shown there is little possibility at present of obtaining resistant apple and pear trees of desirable quality.

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LIME-DEFICIENCY IN THE KING-COUNTRY.

MAIROA "DOPINESS" OR SHEEP SICKNESS.

B. C. ASTON, Chief Chemist, Department of Agriculture.

IT may be recalled that the writer, drawing attention to "dopiness" in sheep from the preliminary investigation of a typical Mairoa farm (this *Journal*, September, 1928), pointed to the great necessity for lime on all farms in this district where sheep refused to develop normally, and that many reasons were given why liming should be regarded as an essential treatment of such lands. This has been regarded by some as ignoring the necessity for top-dressing with phosphate, although it was never intended that any such construction should be placed on the advice given, and the writer publicly stated as early as November, 1927, that no one could expect to farm in the Mairoa district without using phosphate.

The results obtained in the field during the last two years in combating this dopiness in sheep afford an example (in addition to the discovery of the cure for bush sickness in cattle and sheep in another district) of the very great value which must be attached to the results of scientific research, and not least to chemical research, in agriculture. In both the cases referred to it was undoubtedly chemical analyses of soils and pastures which so supported the chemist in his opinions that he insisted on the dictates of theory being followed by experiments with a view to discovering a cure. In troubles which are common to large areas of country there are bound to be some farmers who may hit on the right method of treatment, or suggest it, and yet on account of having no backing from scientific authorities they neglect to persevere in the application of any particular idea. Thus, in the case of bush sickness iron remedies were suggested and even tried in a half-hearted manner long before any chemical research had been done on soils and pastures. These efforts were not persevered in, but after a few days' treatment the administration of iron salts to the animal was abandoned as inefficacious. It was not until the chemist had analysed soils, pastures, and animals' blood, and found iron extremely deficient in all three cases, that long-continued treatment of the animals on iron remedies was tried and found to be successful.

In the case of Mairoa the use of lime as a soil-treatment had undoubtedly been suggested and even spasmodically followed by farmers in the district, but this lime-treatment was only one of many others which were suggested and tried in a speculative manner among other remedies, including potash, phosphate, and even nitrogen, and it was not until the chemist * not only advised liming, but showed that it was essential to success, that the advice was followed generally and has been successful.

The solution of these two troubles, largely due to wide outlook by the authorities in making funds available for research, will, it is confidently predicted, add substantially to the wealth of the country,

* As a matter of fact, three chemists working independently on the soils of Mairoa confirmed the Chief Chemist's original opinion as to the extreme need for lime.

since millions of acres are in the aggregate affected by these deficiencies. It will be recalled that Dr. Orr, head of the Rowett Research Institute in Animal Nutrition, visited the Mairoa district in 1927 and approved of the extensive experiments subsequently carried out, for which a grant of money was set aside at Dr. Orr's instance by the Empire Marketing Board.

Practical Field Demonstrations in Treatment.

Following is a brief account of the Mairoa research, giving some account of the practical work done in the field by Mr. C. F. Sutherland, Mr. C. M. Wright, and others who are charged with the duty of demonstrating in a practical manner to the farmers' satisfaction the need of lime in this once fertile district. It should be premised that in the Mairoa Hundred the prevailing subsoil type is that characteristic of deep volcanic mud or dust showers, which may be called the Mairoa type.

(1) The natural plant-covering of Mairoa consists largely of rimu. tawhero, and hinau forest. In addition to this, there occur in the district to such a small extent as to be almost negligible some of the following types, which are, however, well developed in other areas outside the Mairoa district.

(2) Mangapohoe, which naturally grows tawhero, rewa, and tree manuka. This type is more unhealthy for sheep than the first.

In addition to the above unhealthy types of country, there are three healthy types, namely :—

(3) Kihikihi, which grows rata, rimu, matai, tawa, and mangaeo.

(4) Waitangururu, which grows rata, pukatea, matai, totara, rimu, konini, and mahoe.

(5) Mangaotaki, which grows forests similar to No. 4.

Both these types may have very dense undergrowth. The first two types consist of volcanic dust or mud showers, the latter mixed with sandstone, and the last three types of soil are derived mainly from sedimentary deposits. Types 1 and 2 were very productive for a number of years. The pastures on them are from eighteen to twenty-seven years old, and are now reverting to danthonia, brown-top, fog, weeds, moss, and fern, and it is to be noted that in addition on the No. 2, Mangapohoe type, manuka is coming in. In both, clovers are absent.

Regarding the adjacent healthy types, on the Kihikihi land the pastures are reverting to danthonia and brown-top. They still have a fair amount of cocksfoot and a little rye-grass and clover, but moss, fog, fern, and weeds take up a good deal of these pastures also. Waitangururu pastures have deteriorated, but still contain a good portion of the original grasses sown. Clovers are holding better than any other types, and fern does not come in nearly so quickly.

The above gives a bird's eye view of the types of subsoil in the large area to the east of Te Kuiti, but it should be said that in the Mangapohoe there is evidence of a deficiency of phosphate as well as calcium in the soil.

Before the present experiments were instituted top-dressing of pastures was spasmodic and confined to small areas, the dressings being largely phosphatic, chiefly of basic super, basic slag, and superphosphate. This treatment produced better pastures, but did not cure dopiness

in sheep. The Mairoa district before the war period was producing heavily, and was considered one of the good districts of the King-country. It is important to remember this, as it affords a distinguishing difference between "bush-sick" country and "dopy" country. Mairoa is a good example of deteriorated land, but bush-sick country always gets better with age and stocking. This matter was discussed in a paper, "Lime Deficiency in the King-country Soils," and the effect on plants and animals (*Transactions, New Zealand Institute*, Vol. 59, 1928, p. 406), where the history of the country is given. The publication of this and the *Journal* article already referred to drew attention to the need for lime, and preliminary experiments with lime carbonate alone, gypsum alone, and with lime and superphosphate mixed were successful in keeping sheep free from dopiness. (See 1929 Annual Report, Scientific and Industrial Research Department, pp. 24, 25, and this *Journal* for July, 1930, p. 14.)

Since then the experiments have been mainly in the direction of practical tests on farmers' lands, the test being whether the previous well-authenticated mortality which always occurred could be stopped. To this end a farmer on the Mangapohoe soil-type (which happily does not represent any great area of country), where is the poorest farm in the district, instituted experiments. In this farm malnutrition showed itself at a very early stage. Pastures were rapidly deteriorating, and sheep would only thrive for a short period. The owner, realizing the seriousness of the matter, top-dressed paddocks with superphosphate and slag, but the malnutrition was not thereby averted. In June, 1928, 18 acres not previously top-dressed were dressed with a mixture of 5 cwt. lime carbonate and 2 cwt. superphosphate per acre. This produced marked pasture improvement, especially in the clover content. In March, 1928, 170 ewes brought in here were tupped on the place, with the intention of selling in June. Of these 150 were sold; the remainder were too weak to travel. These twenty were put on the 5-2 top-dressed paddock; two died, and the other eighteen produced nineteen lambs; both lambs and ewes fattened. Twenty dairy cows were also grazed from time to time on these pastures. This success with sheep encouraged the owner to purchase one hundred ewes in March, 1929. These were run on the non-top-dressed paddocks and tupped there. When they had lambed they were moved on to the top-dressed pastures and grazed there continuously. Towards the end of August, 1929, a second application of 5-2 lime-super mixture was applied to the area of 18 acres, and the adjoining area of 14 acres non-top-dressed had the same mixture applied. From these one hundred ewes there were ninety-eight lambs; fifty-five were sold fat to a buyer, four were killed for the household, and one was missing. The remaining thirty-eight were kept on the property until March, 1931, when all but twelve were sold fat. Out of these thirty-eight lambs twenty-nine were weighed periodically. The average weights for the spring months show that there was an average gain to November of $21\frac{3}{4}$ lb., which is satisfactory for malnutrition country. The average weight of the wool from each lamb* was 8 lb. 14 oz. The average weight of typical Mairoa lambs of the same age as those used in this

* In this and other accounts the term "lamb" is used for hoggets at this stage for convenience in continuity of description.

experiment is about 50 lb., and the average weight of wool about 4½ lb. The quality of the wool was better than that of the average Mairoa lamb. The experimental lambs weighed in July 69¼ lb.; August, 66 lb.; September, 71 lb.; October, 76 lb.; November, 87¾ lb.

From the 100 ewes eighty were drafted out to rear another lot of lambs; another 120 were bought, and the two lots, 200 all told, were treated as formerly, but wintered on the top-dressed paddocks and lambed there. From the new lot of 120, 90 per cent. of lambs were docked, the eighty from the old lot producing 110 per cent. against the 98 per cent. in the previous year, and the last lambs were a very much more even line and better framed, no doubt through the mothers being pastured for a long time on the land top-dressed with 5-2 mixture. Of the two lots 183 ewes lambed, and 183 lambs were docked. In the first draft there were seventy fat lambs, in the second draft sixty-one, and third draft twenty, making a total of 151 fat lambs. The average weight of the two first drafts was between 31 lb. and 32 lb.

The same lot of ewes—*i.e.*, 80 plus 120—were again tupped this year. This will be the third lot of lambs to be produced by the eighty ewes, which are doing splendidly to date of writing. The owner of this farm has up to the present top-dressed approximately 200 acres with the 5-2 lime-super mixture, some areas having had one top-dressing, others as many as four. For instance, two small paddocks, one of 14 acres, have been top-dressed three times, and an 18-acre paddock four times. The latter pasture could almost be called ideal, and should carry two sheep to the acre and do them well. This place during last winter, on 140 acres top-dressed and 60 acres not top-dressed, wintered and did well 200 breeding-ewes, forty wethers, thirty-eight hoggets, and twelve rams, a total of 290 sheep; also forty calves and twenty dry cattle and twenty milking-cows came on again in September, but were assisted with hay. The carrying-capcaity would be equivalent to one and a half sheep to the acre.

On another farm, two-thirds of which is situated on the Mairoa type of subsoil, the remainder being Mangapohoe type, the forest was felled and burnt twenty-two years ago. This farm adjoins the previously mentioned place at Waitangururu, and is now the property of a bank. According to the previous owner there were always lambs that did not thrive, although he had top-dressed the paddocks with different mixtures in 1927, such as basic super 2½ cwt., basis slag 2½ cwt., and superphosphate 2½ cwt., per acre, and a second application of similar mixtures was applied in the following year on each area. The pasture was improved by means of these purely phosphatic top-dressings, but the sheep trouble was not cured. In fact, on that area top-dressed with superphosphate the sheep died more quickly than on any other area, and it was also noticed that sheep would not graze there if they could get off it. During April, 1930, 250 acres of this farm was top-dressed with the 5-2 lime-super mixture, applied over the area previously top-dressed with phosphate alone. This lime treatment effected marked improvement in clovers and stimulated a vigorous growth of the English grasses. The land was badly infested with ragwort.

A purchase of 265 ewes in April, 1929, which were depastured on the land dressed in 1927–28 with phosphate alone, only yielded

70 per cent. of lambs, and by November the ewes and lambs had to be taken away, as many were dying. A further purchase of 200 ewes was made in May, 1930, and these sheep were continuously carried on the 5-2 top-dressed area. Of this lot 90 per cent. of lambs were docked, an increase on 20 per cent. on the previous year's results. Running with these ewes were wethers and a few cattle intermittently. These ewes and lambs are still on the farm and are doing well. This is the first time for many years that sheep have been carried through without the sheep going sick.

Five other farms, mainly on the Mairoa type of subsoil, were inspected. On these, two of the farmers had had the same experience with the use of basic slag, basic super, and superphosphate when they were used alone, but exact details could not be obtained of their results, as they had gradually gone in for dairying. They were sure, however, that the heavy dressings of lime and superphosphate would be the means of carrying healthy sheep throughout, as both had experienced the fact that dopy sheep put on to these areas top-dressed with lime and super 5-2 mixture had recovered. These farmers were all elated with the results from the lime supplied by the Department of Agriculture, and hoped that it could be continued to be supplied on the same terms until some of their country on each farm had been brought back to good pasture. They had reported that there was the same marked improvement in the pastures when lime had been used with the super, especially regarding the prevalence of clovers.

Another farmer, located on the Kihikihi type, who had always been able to breed and rear his own sheep, but on whose farm the carrying-capacity had decreased considerably and the sheep had become smaller-framed and the percentage of culled lambs larger, also gave his experience. The pastures of this farm are twenty-five to thirty years old, and the carrying-capacity previous to top-dressing was a little over one sheep to the acre. Not being troubled with dopy sheep, the farmer has endeavoured to cover as much ground as possible and has used a 50-50 mixture of lime and super at the rate of 2½ cwt. per acre. This has no doubt improved the pastures, but the area treated with the 5-2 mixture is greatly superior. The best pasture on this section is one that was top-dressed with 1 ton of lime per acre in 1928, and after that two dressings of 50-50 mixture at the rate of 2½ cwt. per acre. It is considered by the farmer to be his best paddock. There is also another good paddock top-dressed with the 5-2 mixture in 1928, and which has also had one application of 50-50 mixture last season.

Four other farms were inspected on the Waitangururu type, the pastures of which have never reverted to the same extent as the Mairoa and Mangapohoe types, neither has the fern gained ground in the same way. Sheep have always been bred and reared successfully on these properties, the pastures of which are from twenty to twenty-seven years old. The carrying-capacity on these farms had slightly decreased, and there was a small percentage of undersized lambs. Top-dressings with super and slag had been used on some of these areas, with good results as regards pasture. Stock had evidently benefited also, but all the farmers agreed that lime and super 5-2 mixture produced the best results. From observations slag dressings were almost as good. It has been usual for this group of

farmers to sell their lambs outright or as a line. One farmer since using the 5-2 top-dressing has sold his fat lambs this year on the hooks at the freezing-works. Out of 310 lambs 246 went off fat in three drafts from January to March, the average weights being 33 lb., 31½ lb., and 31 lb. respectively. These lambs were all off the 5-2 mixture once-treated pasture.

Conclusion.

The conclusion arrived at with regard to the year's experience with lime and super top-dressing treatment is that these two ingredients must be mixed to obtain the best results, rather than be applied separately to the pasture. In several instances where the lime and super had been applied separately the results were not so good as anticipated. It is thought that after four applications of the 5-2 mixture, with proper management, the carrying-capacity of the Mairoa country should be improved to about 2½ sheep per acre. The Government supply of lime to the farmers has been a great assistance, but the maximum improvement cannot be obtained without the use of superphosphate. The mixture of 5 cwt. of lime and 2 cwt of super per acre applied to the land has proved that it is possible to successfully breed and fatten lambs on country where formerly it was impossible to do so.

Some reorganization of the work in the Mairoa and Kopaki areas has been made as a result of the experience already gained. Carefully controlled experiments have been initiated at Mairoa to compare the effect of various top-dressings on the health of sheep. A large series of replicated enclosed plots, with various top-dressings, have been established at Kopaki and Mairoa. A series of samples of uncontaminated pasture from these plots is being obtained, whereby it is hoped to secure exact data concerning the variation in mineral content and composition of the pasture with soil-type and manurial treatment.

A USEFUL DISINFECTANT FOR USE IN COW-SHEDS.

The objection to most of the disinfectants one sees in cow-sheds is the fact that they are very liable to taint the milk if used extensively. When udder and teat troubles are prevalent the farmer is often puzzled as to what disinfectant to use, but the following formula provides a solution that is cheap, effective, and does not give rise to any milk taint: 1 lb. chlorinated lime (Calx chlorinata), 4 lb. washing-soda (soda carbonate crystals), 1 gallon of water. Dissolve the soda in a gallon of hot water and allow to become cold. Stir in the chlorinated lime, add 6 oz. of common salt, and agitate at intervals for an hour. Cover and let the mixture settle. Bottle the clear fluid, cork, and keep in the dark, as light causes the hypochlorite solution to alter its composition. Use ½ pint of this stock solution to, say, 4 gallons of cold water for washing teats, dipping teat-cups after milking each cow, &c. There are several proprietary lines of this nature on the market, but this fluid can be prepared at a much cheaper rate, and is equally effective. If dairy factories would purchase chlorinated lime in bulk for issue to suppliers, the cost would be reduced by at least half. The only objection to this disinfectant is that it is unstable and needs to be freshly made about once a week. The addition of the common salt helps to make the solution more stable.

—T. H. Hankin, M.R.C.V.S., B.V.Sc., Veterinarian, Masterton.

CERTIFIED RYE-GRASS SEED PRODUCTION.

OTAGO-SOUTHLAND EXPERIENCE IN THE PAST SEASON.

R. B. TENNENT, Fields Superintendent, Department of Agriculture, Dunedin.

PERENNIAL rye-grass has assumed the most important place as a foundation grass in New Zealand pastures, largely on account of its adaptability to varying soil and climatic conditions, and its inherent ability of producing palatable foliage over a long period of the year. The recognition of this has ultimately led to its being regarded by all farmers as an ideal pasture base, with the result that of all grass-seed grown in New Zealand it easily takes pride of place. Naturally the bulk of the rye-grass seed produced in this country is used within the Dominion for the renewal of old pastures and the establishment of new ones, comparatively little export taking place.

It is of considerable interest to note that during the season 1929–30 9,922,727 lb. of perennial rye-grass seed was produced, and of this amount the North Island harvested 1,120,729 lb., as against 8,801,998 lb. in the South Island. The South Island, therefore, is the main source of production, this fact being largely accounted for by the rotational cropping practised there, necessitating as it does the frequent breaking-up of pastures for the growing of crops. When such land after having been cropped is sown down again to grass, the usual practice is to harvest a seed crop within the first two years, the farmer usually securing a good monetary return which more than repays him for his labour and cost of production. In this manner an internal seed trade has evolved in the Dominion which occupies an important place in the farming programme.

This type of farming has reached its greatest intensity in Otago and Southland, which last season produced 6,031,637 lb. of perennial rye-grass seed, practically two-thirds of the Dominion's total production. Consequently any adverse movement affecting the reputation and subsequent sale of Southern seed is of paramount importance to growers, and the fact that severe criticism has been made during the past few years as to the value of Southern seed for the production of first-class permanent pasture has aroused considerable interest, naturally admixed with strong feeling, on the part of growers in the South.

Recent research work by Levy and Davies at the Plant Research Station, Palmerston North, has conclusivcly shown that New Zealand rye-grass is not a homogeneous species, but is comprised of many individual types; and as an outcome of painstaking investigation they have classified the bulk of rye-grass produced in New Zealand into six distinct types. Of these, two may be considered as truly perennial and as practically equal in value as herbage-producers, whereas the remaining four types range from false perennials (Type 3) to genuine annuals (Type 6). These latter, either from the fact of their low production ability and incapacity to recover after hard grazing or cutting, or to their purely annual habits, are of relatively low value, being practically useless for the establishment of permanent pastures. (See article, "Perennial Rye-grass Strain Investigation," by E. Bruce Levy and Wm. Davies, in this *Journal* for June, 1930.)

Unfortunately for growers of rye-grass seed in Otago and Southland, these two investigators have shown that the bulk of seed falling into Types 1 and 2 (that is, true perennials of a desirable nature) is produced in the Hawke's Bay, Poverty Bay, and Sandon districts, in the North Island, whereas the inferior to worthless types are dominant in the South, over 90 per cent. of the seed harvested there falling into Types 3, 4, 5, and 6. It thus will be seen that rye-grass seed production in Otago and Southland is built up on an unsound basis, in that the so-called perennial rye-grass of the South, produced annually in large quantities, is not of a truly perennial nature and in the main is unsatisfactory for the establishment of permanent pastures.

This briefly summarizes the contentions of Messrs. Levy and Davies, and widespread experimental work throughout the Dominion has conclusively proved the correctness of their assertions. This finding has been a bitter one for Southern growers, and even yet many refuse to accept it, but it is only by a recognition of the facts that the growing of rye-grass in the South will be put on a proper basis.

The Department of Agriculture, in order to assure itself that the good strains of rye-grass would under Southern conditions of growth assert their superiority over ordinary commercial strains, undertook a series of trials in different parts of Otago and Southland. As a result of observations carried out in these experiments, conclusive evidence was forthcoming that the locally grown Southern seed, and seed from other parts of the South Island, was inferior to the best strains of rye-grass from the Hawke's Bay, Poverty Bay, and Sandon districts. It was also noted in these trials that some of the commercial strains from the South were much superior to others, and the trials clearly demonstrated the great variations existing in commercial samples of seed and the necessity for only growing approved strains of the correct type. These trials covered a wide range of soil and climate, being conducted at the following places: Gore Experimental Farm, Winton Demonstration Farm, Carterhope (Donald McDonald), Tapanui (K. Rodger), Waikaka (H. R. Henderson), and Wanaka (P. R. Sargood).

Having clearly demonstrated the weakness of the rye-grass seed production in the South, an effective remedy has been offered to farmers by the scheme of rye-grass seed certification, whereby the Department of Agriculture undertakes to certify to any rye-grass seed produced in the Dominion as having genuine perennial characteristics if it conforms to set standards, such seed being sealed and tagged with an official certificate. Thus a warranty is given to purchasers of certified seed that such is suitable for the production of permanent pastures.

In Otago and Southland a number of farmers desirous of producing the most desirable type of rye-grass seed obtained supplies of Government certified seed or its equivalent from the North Island and sowed this down in 1929, at the same time registering their crops for the production of certified seed. Despite the preliminary experimental work carried out at the various places named above, there appeared to be some doubt in the mind of the average Southern farmer as to the adaptability of what was generally referred to as Hawke's Bay seed (*i.e.*, Type 1 and 2) to Southern conditions, with the result that considerable local interest has been taken in those pastures sown down in certified seed.

Experience in 1930–31 Season.

During the season 1930–31, 441 acres passed field inspection, the seed produced being certified. These crops were kept under close observation throughout the growing-period. On practically every farm the germination of the seed was good, and excellent "strikes" were obtained. The crops, in the main, grew well, and were quite equal in rapidity of establishment to the locally grown seed. Several growers asserted that the certified seed established more rapidly, and appeared superior to the ordinary rye-grass sown elsewhere on their farms. The bulk of the crops were closed for seed-production, and heavy growth resulted, leading farmers to believe that heavy seed crops would be obtained. In some cases the growth was so heavy that great difficulty was experienced in harvesting. Unfortunately the harvest season of 1931 in Southland and South Otago was an extremely bad one, wet conditions with cold winds prevailing, and as a result the seed harvested from the certified crops was adversely affected as regards germination capacity. This feature was common to all rye-grass seed produced in these districts, but there can be no question that the germination of the seed from the certified areas was much lower than that obtained from the ordinary Southern-grown seed.

It would thus appear that when grown under wet, cold conditions, particularly when such occur at the time of flowering, genuine perennial seed from the North Island is more susceptible to such adverse conditions than acclimatized Southern seed, and that under such conditions germination is likely to be low. This only emphasizes the necessity of farmers in the South producing their own supplies of certified seed, in order to have it acclimatized to local conditions. It has, however, to be stressed that, although from this year's experience growers have been disappointed with the germinating capacity of their seed produced from certified rye-grass, the actual pastures established have in no way suffered from the wet season. These have come up to expectations, and time will clearly show that such pastures will be much superior to those sown down with the inferior types already referred to.

It has also to be pointed out that in North Otago, where conditions were much drier and warmer during the harvest season than was the case farther south, good crops of certified seed were obtained and the germination of the seed was in every way excellent.

The results of the past season's trials with certified rye-grass have thus been most successful in North Otago in every respect. In South Otago and Southland, although the pastures sown down with certified seed have established rapidly and grown excellently, producing reasonable crops of seed, it is unfortunate that the germination of such seed has been low. This, however, must not be regarded as damning evidence as to the unsuitability of certified rye-grass for the South. Rather must it be taken as an indication of the necessity of extending the growing of this type of rye-grass for the establishment of permanent pastures, to the exclusion of all inferior types, so that acclimatized strains may be rapidly produced. In conclusion, it can be positively asserted that given a normal harvest season, certified rye-grass will produce seed of high germinating-capacity in Southern districts.

COCCIDIOSIS IN POULTRY.

NATURE AND CONTROL OF THE DISEASE.

F. C. BROWN, Chief Poultry Instructor, Live-stock Division.

COCCIDIOSIS, according to reports received, has become a serious menace to the poultry industry in various parts of the world, causing heavy mortality among chickens during the growing stage. That this parasitic disease is by no means a new one so far as New Zealand is concerned is borne out by the fact that for many years past there have been received at the Wallaceville Veterinary Laboratory chickens ranging from ten days to ten weeks old which, as a result of microscopical examination, proved to be more or less affected with the parasite responsible.

It was only in isolated cases, however, that any considerable mortality was reported from affected poultry plants, and usually the chief ground for complaint was the failure of the young affected birds to thrive and to make proper development. Generally speaking, these birds came from plants where they had been subjected to improper management, chiefly in having to live in unclean houses, and in being compelled to run on what might be termed poultry-sick ground. It was also generally observed that on appearance they did not possess the necessary stamina to combat the infection when they came into contact with it.

In most cases on these affected plants, when the weak methods of breeding and general management were corrected, the trouble was soon stamped out. In view of this, coccidiosis was not generally looked upon as a disease likely to become a serious menace to our poultry-keepers, and was therefore regarded in a similar light to the many other common ailments that affect poultry. Unfortunately, however, of late a much more virulent form of the trouble has been established in certain districts, and older birds—pullets from five to six months old—many of which were examined at the Wallaceville Laboratory, proved to be badly infested with the parasite. The worst affected birds were received during last autumn, and in most cases from plants where considerable mortality had and has since taken place. The majority of the birds examined were White Leghorn pullets ranging from four to six months old.

Birds thus affected were sent by several owners, and some were from among the best-managed plants in the Dominion. From inquiries made, however, it has been ascertained that, with the exception of three plants, none of the affected birds were bred by their then present owners, but were stock which had been purchased, usually by public auction. Obviously the birds carried the disease in a partially developed stage to the plants of their new owners. In some cases the birds were placed under ideal conditions in the way of housing, and on fresh ground to which fowls had not previously had access, but, notwithstanding this, and the fact that they were provided with good and liberal feeding, they generally failed to thrive, and consequently heavy losses took place.

The question arises here as to whether the parasite has become more virulent of late, or whether its more harmful effect is due to

lowered vigour in the birds affected and insufficient resistance to combat the infection. Whatever may be the case, the presence of the disease in the virulent form referred to, and from what the writer has seen of it, is sufficient to indicate that it is one of the most serious diseases the poultry-keeper has to contend with at the present time, for in addition to its fatal nature it can be extremely easily conveyed from one bird to another. Only those who have had experience in trying to combat the disease when it has gained a good foothold can realize how very much better it is to prevent than to wait until it becomes necessary to resort to curative methods.

The more intensive the system of poultry-keeping, the greater the need for the maintenance of the most exacting conditions. This emphasizes the necessity of taking every means of preventing the disease from becoming established, for once the trouble has gained a foothold it is a difficult matter to check it, and even if it is checked very serious losses will probably have taken place. Indeed, scientific investigators in other parts of the world who have conducted research in connection with the disease over a long period of years freely intimate in reports received that preventive measures are the only satisfactory way of dealing with it.

Life-history.

Coccidiosis is caused by a microscopic parasite *Eimeria avium*. This parasite develops and multiplies in the cells of the walls of the intestines, which as a result are broken down, so that food is not absorbed and the bird starves. As more and more of the intestinal cells become affected and destroyed, the parasite commences forming male and female elements which unite and produce a different stage, which finally is voided in the droppings and infects the ground, and in about four days is ready to re-enter a host. It is at this stage that healthy growing stock are apt to become affected when allowed to run on infected ground. This is a very resistant stage in the life-history, and is called the oocyst stage.

Many oocysts are ruptured if conditions are not favourable to their development. They develop best under warm, moist, and shady conditions, and especially where strict cleanliness is not observed. On the other hand, dryness and sunshine are the greatest enemies of the parasite. This means that the house should be maintained in a clean dry state; also it should be open in front and arranged in such a way that the sunlight will penetrate to practically all parts of it, thus ensuring that the litter, &c., will not become damp or wet. As previously indicated, if the house is maintained in a dry state the oocyst is deterred from developing, hence the birds are not so liable to become affected. Older carrier birds are the chief culprits in infecting ground, and young birds lacking in stamina are highly susceptible should they come into contact with the infection.

The run is also a great source of danger, for the germs of the disease will survive in the soil for a considerable time. Where affected birds have had access to runs, however, it is extremely difficult to clean the ground. All coverings, such as long grass, should be removed in order that the ground may get as much of the sun's rays as possible. It should also be given a good application of burnt lime, and at a later date be turned over, sown down, and given a long rest.

Contributing Causes.

A common mistake made in the laying-out of poultry plants is to have only one run allotted to each house. The result is that by constant stocking the run soon becomes poultry-sick, and, having no opportunity of being spelled, it provides a harbour for germ-life of all kinds. Moreover, if disease does appear, proper measures cannot be taken to prevent the trouble from spreading. The importance of having two runs to each house, and allowing the birds access to them alternately, can scarcely be overstated; no poultry-plant, in fact, is complete unless there is an alternate run to each house. In this way a certain area of ground can be turned over or spelled each year and allowed to sweeten.

Where there is only one run to a house, on which affected birds have had access, the only safe course to adopt with this season's chickens is to confine them to the brooder-house right through the brooder stage, and to do everything possible to lessen the risk of infection. Then when the young birds are transferred from the brooder they should be placed on clean ground to which adult stock have not had access for a considerable time. To place chickens in runs which have become stale and dirty through adult stock, or to allow young stock to run with the latter, is simply courting disaster. Even if one is certain that the parasite is not present, it will be found a wise preventive measure to adopt the same means as if it was present.

Coccidiosis and other forms of parasitic life can always be better controlled when the floor of the house is made of concrete. Obviously an earth floor increases the difficulty of getting rid of the parasite once it makes its appearance in the brooding quarters.

Experience shows that the use of disinfectants has little effect in destroying the parasite. It is claimed that if the interior of the brooder-house is well and frequently sprayed with boiling water this will have more effect in destroying the infection than disinfectants.

Symptoms.

Usually the first sign that young chickens are affected with the parasite is the passing of blood in the droppings, and failure of the birds to thrive and make proper development. When older birds become affected—pullets from four to six months old—the symptoms generally shown are weakness in leg-power and failure to walk in an alert manner, shrinkage of the comb, and gradual wasting, which is especially seen in the shrinking of the muscles of the breast, leaving the breast-bone standing out as a sharp ridge. The bird gradually weakens until death occurs, at which stage the victim presents an extremely emaciated appearance.

The outward symptoms of the disease may easily be confused with those manifested when tuberculosis or intestinal worms are present, and the only way of definitely determining whether the disease is present or not is by a microscopical examination. Poultry-keepers who suspect that the disease is present on their plants should therefore forward one or more of the suspected birds to the Officer in Charge, Veterinary Laboratory, Wallaceville, for examination purposes.

Control Measures.

While preventive measures are the only safe means of controlling this disease, certain cures have been recommended. It is claimed that the feeding of milk, whether in a dry or liquid form, is conducive to an acid condition of the intestine which tends to give the bird greater resistance to the parasite.

The following extract from an article dealing with coccidiosis, by W. R. Kerr, Lecturer in Veterinary Science to the Harper Adams College, England, may prove of interest :—

> The possibility of iodine in this connection seemed impressive, and experiments were carried out to find the most convenient form in which it could be efficiently administered. It was decided to use the power of casein to adsorb iodine for this purpose. Casein in milk can adsorb large doses of iodine by the application of heat, and it was found by experiment that this combination did not affect the hydrolysis of amino acids, and also that iodine was set free to combine with other organized matter to be forced out in the excreta. This preparation seemed to fulfil the desired conditions, and its use was extended to field work.
>
> The combination is as follows: Iodine, 1 part (¼ oz.); potassium iodide, 2 parts (½ oz.); water, 50 parts (25 oz.). To a quart of fresh separated milk add 3 oz. of the iodine solution, and heat until it becomes white. This is the stock solution, and 1 pint should be added to every gallon of drinking-water used. The chemical nature of the complex formed is popularly ascribed to the formation of colloidal iodine. Excellent results have been obtained from the use of this treatment on poultry-farms in this province.

The author further states that he has obtained very good results with this treatment in several recorded outbreaks. It may be well to again emphasize that once this disease makes its appearance drastic methods of suppression are most necessary, and no time should be lost in thoroughly cleaning up the plant and removing all sorts of infection, chief among which are the droppings of affected birds. Above all, never place growing stock on ground to which adult birds have recently had access.

Where an outbreak has made its appearance the procedure should be as follows :—

(1) Ensure dry conditions for affected birds.
(2) Feed a milk diet.
(3) Try iodine in milk as a curative agent.
(4) Kill off badly infected birds, as they may always be carriers.
(5) Lime, turn over, and sow down affected runs.
(6) Chickens may be run on false wire-netting floors, which will minimize the risk of the birds coming into contact with the droppings.
(7) Do not purchase stock from other than guaranteed clean plants, or, better still, rear your own chickens from parents which have undoubted signs of constitutional vigour.
(8) Feed the birds well from first to last with a nourishing diet, so that they may be maintained in the best possible condition ; it is also important that continual warfare be made against insect vermin.

Coccidiosis and the Poultry Act.

As a means of preventing as far as possible affected stock from being sold in the future (to which practice, unfortunately, some breeders have already resorted), and in order that the Department of Agriculture may be able to deal effectively with affected plants, coccidiosis has recently been formally declared to be a disease for the purposes of the

Poultry Act, 1924. It should be the aim of all poultry-keepers, whether large or small, to assist the Department in its endeavour to prevent this and other infectious diseases from spreading. It is realized that such a result will never be satisfactorily achieved unless drastic steps are taken to stop poultry-keepers and others from disposing of infected stock. Therefore the Department will insist that this practice be stopped as far as possible, under the powers conferred by the Poultry Act.

Following are some relevant extracts from the Act :—

No person shall knowingly sell, or offer or expose for sale, or have in his possession for sale, any poultry which is diseased.

Every owner of poultry shall within twenty-four hours notify an Inspector of any outbreak of disease discovered or suspected amongst his poultry, and shall either forthwith destroy any birds which are diseased or suspected to be diseased, or, as far as practicable, isolate any such birds from other birds.

Every person who obstructs any Inspector or other officer in the performance of his duties, or who fails to comply with any direction given by an Inspector or with any of the provisions of this Act, or who commits any offence against this Act, shall be liable on summary conviction to a fine of twenty pounds.

Poultry-keepers and others concerned in the sale of poultry would be well advised to procure a copy of the Poultry Act and become familiar with its provisions. Copies may be obtained from the Government Printer, Wellington, at a cost of 6d. each. (The Act was also published in full in this *Journal* for December, 1924.) The appearance of any infectious disease should at once be reported to the Director of the Live-stock Division, Department of Agriculture, Wellington.

TESTS OF LOCALLY GROWN LARCH FOR BUTTER-BOXES.

W. C. WARD, State Forest Service, Wellington.

DURING immediate post-war years the growing scarcity of native white-pine and its rising price, due to increased extraction costs, led the dairy industry of New Zealand to seek substitutes for the manufacture of butter-boxes. Suitable native timbers were in restricted supply, silver-beech being the only one in commercial use. As a result spruce boxes, which could be landed at the dairy factories at a much lower price than the locally manufactured white-pine containers, have been imported from Canada and Sweden in increasing quantities during the past five years. During 1930 approximately 30 per cent. of New Zealand's butter was exported in foreign-manufactured containers.

In general, the exotic pines, which form the greater part of the forest plantations established in New Zealand, have not been considered suitable for foodstuff containers, owing to the resin in the various species being present in sufficient quantity to produce wood-taint. As information, however, had been received from London to the effect that European larch (*Larix europea*) was used in Czecho-Slavakia for butter-kegs, it was considered that the same species from the exotic plantations in New Zealand offered possibilities as a butter-box timber, and might prove a substitute for the species at present used. As supplies of the timber were available, butter-boxes with larch sides were constructed and the tests outlined hereunder made.

In 1930 the Conservator of Forests, Rotorua, arranged for the sawing of some locally-grown European larch-trees into batten- and scantling-sized pieces. The material so obtained ranged in size from 3 in. by 1 in. up to 4 in. by 3 in. As these small dimensions indicate, it would have been difficult to manufacture the standard ½ in. sided butter-box from this material. However, the "Saranac" type of container used by the New Zealand Co-operative Dairy Company offered a solution of the problem. For the sides, top, and bottom of this box any number of pieces can be used, as they can all be stitched together in a special fabricating machine used for this purpose. Accordingly, a sufficient number of 3 in. by ½ in. pieces were stitched together in the form of a mat to represent the sides, top, and bottom of the box. The ends, however, could not be satisfactorily manufactured in this manner, and in consequence were supplied in white-pine.

The New Zealand Co-operative Dairy Company manufactured the butter-boxes, filled them with butter, and held them in cold storage for the duration of the tests required, which were carried out by the Dairy-produce Grader, Department of Agriculture, Auckland, and consisted of the routine examination for quality. It was decided to grade the butter in the five boxes on delivery at the grading-store, and at intervals of two, three, four, five, and six months while in storage. The Grading Inspector, however, pointed out that repeated defrosting and freezing had a detrimental effect on butter quality, and it was therefore decided to defrost a single different box at each of the periods above mentioned, and to consider this as representative of the whole shipment.

The results of the various grading-tests were as follows:—

Initial grading, 18th October, 1930: Butter first grade.

First inspection, 22nd December, 1930: Butter free from taint. The Grader reported that as the remainder of the churning not used in the tests was packed in Swedish boxes, he had kept one to ascertain whether timber taint would develop on the surface of the butter. It was found that timber-taint in the Swedish boxes was pronounced, confirming the general experience with this container.

Second inspection, 21st January, 1931: Grader reported slight timber-taint on surface of butter, and remarked that larch was more pungent than white-pine.

Third inspection, 20th February, 1931: Grader reported no timber-taint on surface of butter, and explained he was now of opinion that the slight taint reported on the surface of the butter in the January inspection came from the parchment, and not the larch. He further stated that the larch timber was pungent, but did not appear to be objectionable or deleterious.

Fourth inspection, 17th March, 1931: Butter free from taint.

It was originally intended to have a fifth inspection made during April, but unfortunately, owing to a misunderstanding, the butter was disposed of before the time for inspection.

It will thus be noted that after five months' storage butter packed in larch boxes exhibited no signs of wood-taint, indicating that this species offers possibilities as a substitute for the butter-box timbers at present used. In order to confirm the results of the tests on a commercial scale, it is hoped to forward a small shipment of butter packed in larch boxes to England for grading tests at that point.

SEASONAL NOTES.

THE FARM.

Tillage Factors.

On most farms an extremely busy period is at hand, provided weather conditions permit of field work being proceeded with. But it is well to bear in mind that more harm than good may come from the working of wet soils. Just how wet a soil may be and still be cultivated without suffering injury is governed by the nature of the soil itself. Some of the sandy soils may be worked practically at any time, whereas great care must be taken not to work clay soils when they are too wet. It is at times safe to plough old grassland when adjacent land which has been under the plough for some years could not be cultivated without injury to its texture. Hence it is at times possible to keep the implements moving by diverting attention to old grassland earlier than had the conditions been drier. A common cause of relatively poor crop-yields is that the sowing of the seed has not been preceded by sufficient cultivation, and on many farms the only way to rectify this weakness is to miss no opportunity at this season of pushing on with tillage work.

Grass-harrowing.

In general, last month's notes regarding sward-improvement, grass-harrowing, and care in winter grazing are applicable to much of the August and September grassland work.

Grass-harrowing is likely to be much needed on those paddocks on dairy-farms on which stock have been held for winter feeding. In particular, fields from which it is planned to harvest silage or hay during the coming summer should be thoroughly harrowed a short time prior to the date of closing them up from stock.

Pasture Seed Mixtures.

Those faced with the work of sowing down pastures are referred to notes on the subject in the *Journal* for February last (page 127), in which some matters relative to pasture seed mixtures were discussed. Fortunately, developments in our knowledge during recent years have simplified rather than complicated the task of fixing the details of a pasture seed mixture. One result of this is that three seed mixtures prove sufficient to cover the requirements of the great majority of farmers who will be sowing pasture seed at this season.

First of all there is a seed mixture for a temporary pasture of one or two years' duration. Such pastures are at times of considerable value, because they can be used either to spell and to build up the fertility of land which has been regularly under the plough, or to clear land of weeds such as blackberry prior to the sowing of a permanent pasture. A mixture which has been used with success for the sowing-down of temporary pasture consists of 25 lb. Italian rye-grass and 4 lb. to 6 lb. of red clover per acre.

For what are called short-rotation pastures a somewhat different mixture has been found advisable. A short-rotation pasture is intended to have a life of two or three years. Such pastures serve a useful purpose mainly on those farms on which, principally because of climatic conditions, cereals and other arable crops rather than pastures are the main considerations. On such farms short-rotation pastures give the land a beneficial rest, produce heavily during their life, and fit in well with management requirements.

In special cases they may be well justified under conditions which ordinarily call for the use of a permanent-pasture mixture. For instance, if land is known to be incompletely cleared of tall fescue it is usually good practice to sow it down in a short-rotation pasture rather than a permanent one. The short-rotation pasture may be ploughed down when the secondary invasion of fescue becomes serious enough to justify this course, and eventually the land, when cleaned of the fescue, may be sown in permanent pasture.

A suitable seed mixture for the establishment of short-rotation pastures consists of Italian rye-grass, 15 lb.; perennial rye-grass, 15 lb.; red clover, 4 lb.; white clover, 2 lb.

For permanent-pasture establishment the following mixture has been prescribed by Mr. Bruce Levy, Agrostologist, as suitable for use over wide areas in both North and South Islands: 20 lb. to 25 lb. true perennial rye-grass, 10 lb. to 15 lb. New Zealand cocksfoot, 3 lb. crested dogstail, 3 lb. timothy, 2 lb. New Zealand white clover, 3 lb. red clover: total, 46 lb. per acre. The larger amount of cocksfoot is to be used only when the smaller amount of rye-grass is included. The smaller amount of rye-grass is advisable when the summer rainfall is below that needed for good results with rye-grass, as under Canterbury and similar conditions; and again when it would not be economical to raise the fertility of land up to rye-grass standard by top-dressing.

Under certain special conditions the foregoing mixture may with advantage be modified. The following instances calling for modification are given by Mr. Levy: On land of naturally high fertility where the permanence and good growth of rye-grass all the year round are assured, cocksfoot may be omitted. There is only a very limited area of such land. When the cocksfoot is omitted the amount of rye-grass may be increased advantageously to 40 lb., the white clover to 3 lb., and the other species omitted. Poa trivialis at the rate of 2 lb. per acre should be included on high-class country which is damp in the winter. Meadow-foxtail is a grass of high value on fertile swamps too wet in winter for success with rye-grass, and 6 lb. per acre should be included for such conditions; but if it is at all possible to drain such land and make it suitable for rye-grass this should be done and rye-grass sown in preference. In many northern districts of the North Island paspalum at the rate of 6 lb. to 8 lb. per acre may advantageously replace cocksfoot. Strawberry clover at the rate of 1 lb. to the acre may be added for salty marshy conditions, or it may be substituted for white clover on land too wet for the latter.

Most unsuitable seed mixtures are at times recommended for use by farmers—sometimes honestly by persons who have not kept in touch with the developments of the past several years in grassland work. At other times unsuitable mixtures seem to be recommended because they suit the business of the person giving the advice. Unsuitable mixtures may be fruitful of loss over many years, and, in any case, it is a costly matter to rectify a pasture weakness arising from this cause.

Generally the most successful establishment of permanent pastures results when the pasture is not sown with a companion crop, and should such a crop be grown its rate of seeding should generally be lower than that normally adopted. Short-rotation pastures may often with advantage be sown down with oats or barley, but it should be remembered that the better the companion crop the poorer is the pasture likely to be. This is because the shade resulting from the companion crop is apt to be harmful rather than protective. The shading effects of cereals on young pastures is lessened if the cereal is utilized for ensilage or chaff, as then the pasture is subjected to the shading influence for a shorter period.

Top-dressing.

Profitable results, as a rule, follow the application of phosphates to a pasture shortly after it has been sown. The addition of quick-acting nitrogenous material to the phosphate may be worth while if cold conditions prevail, as probably will be the case in the Southern part of the Dominion. Such top-dressing tends to provide the seedlings with extra vigour, which aids them in passing successfully through the critical young stage.

Top-dressing in September of established pastures which have not as yet been dressed will secure extra growth, but it is an open question whether it would not be better to postpone the application until November or thereabouts. If there is promise of an ample supply of growth for all requirements up to Christmas, including ensilage and hay, then the case for September top-dressing is definitely weak. Generally fields which are to be set aside for silage, hay, or seed production should be top-dressed just before they are closed from stock, if top-dressing has not been done fairly recently.

Provision of Special Feed.

It is opportune at this season to consider the fundamental weakness of the grass crop. This weakness is due mainly to two facts. One is that approximately 70 per cent. of the year's total grass-growth occurs in a period of four months—mid-September to mid-January. The other is that the feed-requirements of the stock do not coincide with the grass-growth in quantity and season; as a rule 70 per cent. of the feed is not required in the four months during which it is produced. In brief, the feed-supply does not coincide with the feed-demand. Only proper management will remedy this most common cause of poor results. One of the best means is ensilage, but at this stage all that one can do in this respect is to prepare for next season's work along lines previously described in these notes. Another well-known means is the growing of special crops, which in many districts should be receiving a good deal of attention from now onwards.

In this connection a point often overlooked is that pastures frequently fail much earlier in the season than is thought to be the case to satisfy the requirements of the stock. Actually pastures often begin to prove inadequate from Christmas onwards, whereas many act as if they think this happens only from February onwards. Just what happens is governed to a considerable extent by how well the management is designed to keep the pasture leafy, but frequently, especially on dairy-farms, the summer feed-shortage occurs sooner than supplementary feed is made available to meet it. The danger that has to be faced is not so much deficiency in quantity as deficiency in quality of feed. The feed provided in summer is frequently too woody or fibrous, too indigestible, and too poor in mineral matter. The remedy is the provision of non-woody forage. The keeping of pastures short by means of ensilage and rotational grazing is of valuable assistance in achieving this.

In the warmer districts crops of green maize and millet, provided they are utilized when in a young, leafy stage, are productive of good results, while over wide areas root crops are of particular value. Roots are so highly digestible that they are equivalent to diluted concentrates, and so are of particular value if, as so often happens in summer, grass or other feed, such as green lucerne or green cereals, has been allowed to become somewhat woody and mature. Hence, farmers who are conscious of the fact that they may be unable to provide leafy pastures in summer should at this season give careful consideration to the growing of soft turnips. Often at this season preparatory cultivation for the mangel crop should be in progress. For this crop high fertility and thorough preparatory tillage are highly advisable.

Lucerne and its Culture.

Another crop that specially calls for consideration at this period is lucerne, for which preparatory cultivation could suitably receive current attention. The excellence of lucerne as a forage crop arises from a combination of factors,

including its high yield, high nutritive value, reliability during crucial seasons, low cost of production, and capacity to improve soils. Over a wide range of conditions in New Zealand, lucerne suitably managed will provide three to five " cuts " annually for a number of years. Each cut will contain on the average from 5 to 7 tons of green forage. Hence an acre of lucerne will yield annually in the vicinity of 25 tons of green forage. Frequently the annual yield is in excess of this. As 25 tons of green forage represents a yield of 6½ to 7 tons of hay, the annual production of the lucerne is high.

Investigational work in New Zealand agrees with similar work overseas in showing that the lucerne herbage is exceptionally nutritive, and that it is especially rich in those substances most apt to be lacking in the ration of stock, particularly of the highest-producing animals. The nutritive components of lucerne are also highly digestible, especially when the crop is utilized before it has become woody. Hence green lucerne is very valuable in dry seasons during late summer and autumn. Lucerne hay, because of its high nutritive value, may also be suitably used to supplement feeds which are inferior or low in their content of substances in which lucerne is relatively rich. For instance, lucerne hay and roots may be made to constitute a well-balanced ration because the lucerne remedies the weaknesses of the roots.

One of the most valuable features of lucerne is its deeply penetrating root-system, which fits it well to withstand periods of drought. Hence lucerne may safely be relied upon to make vigorous nutritive growth when practically all other crops fail. Lucerne is outstanding in respect to the quantity and quality of its yield; but if it were not so, and if it were only normal in these respects, its reliability during crucial seasons would be a weighty factor in its favour in comparison with other forage crops that compete with it in popular usage. One is more likely to undervalue than to overvalue the reliability of lucerne during crucial seasons. The relative values of a lucerne crop available when urgently needed and of another crop available when not specially needed cannot be ascertained merely by comparing the crops in respect to the annual yield of nutritive matter. Even if it were true to say that an acre of grass would under certain circumstances produce annually as much nutritive matter as an acre of lucerne, it would not follow necessarily that the products of grass and of the lucerne were of equal cash value. The reliability of the lucerne during critical seasons would almost always swing the balance in its favour even if the other crop equalled it in provision of nutriment—a result which seldom, if ever, occurs when lucerne is successful.

Deep, fertile, open, well-drained loams are undoubtedly best for lucerne. On account of the deep habit of its root-system lucerne does not thrive on a soil which because of bad drainage or impervious subsoil does not allow of deep root-penetration. Good surface drainage and under-drainage are both necessary for successful lucerne.

In selecting land for lucerne it should be remembered also that lucerne is not well fitted to battle against weeds in its early life. Hence it is advisable to avoid land known to be infested with seeds of annual weeds, or with parts of twitchy perennial weeds unless these have been weakened by previous cultivation or cropping.

The Grass-grub.

There are certain points not mentioned in last month's notes relative to the grass-grub which may affect current practice. When the bulk of the valuable species in a pasture have already been destroyed, then the only course to be followed lies in putting the land under the plough, so that a pasture mixture may eventually be sown again. In this connection a point about which a reminder seems scarcely necessary, yet one which is at times overlooked, is that grass or cereal cannot safely follow immediately

after a previous grass or cereal crop which was attacked by the grub. Some of the grubs in the ground are sure to survive the cultivation operations. Even if these do not materially injure the roots of a new cereal or grass crop, they are likely when they reach the egg-laying beetle stage next summer to lay sufficient of their eggs in the shelter of the young crop to bring about serious reinfestation of the ground.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

A Spraying Programme.

THE coming month commences the active operations which have a direct bearing on tree-development and fruit-production during the ensuing season. The operation of first importance is that of protecting the tree from diseases and pests, and to assist in maintaining this most desirable condition the following spray programme is suggested :—

Pome Fruits.

Green-tip : Lime-sulphur 1–10, or bordeaux 5–4–50. Between open cluster and pink : Lime-sulphur 1–30, or bordeaux 3–4–50. Petal-fall : Lime-sulphur 1–100 to 1–120, or bordeaux 3–4–50. Ten days later : Lime-sulphur 1–100 to 1–120, or bordeaux 3–4–50. Repeat at periods from eight to ten days until fruit reaches maturity. Shortly before picking : Lime-sulphur 1–100. Where powdery mildew is pronounced lime-sulphur should be used at green-tip.

Stone Fruits.

Bud-movement : Bordeaux 5–4–50, or lime-sulphur 1–15. Early pink : Lime-sulphur 1–50. Petal-fall : Lime-sulphur 1–125. One month later : Lime-sulphur 1–120. Seven weeks after petal-fall : Lime-sulphur 1–120. Ten days before each variety ripens : Lime-sulphur 1–120 plus 5 lb. precipitated sulphur.

The foregoing recommendations will need to be supplemented or modified according to the locality and conditions prevailing.

Insect Pests.

Chewing insects : Arsenate-of-lead powder 1½ lb. to 100 gallons of water. This quantity of arsenate of lead may be combined with sulphur or its compounds or bordeaux mixture. As a precaution against caustic action arising from its use, 1½ lb. of hydrated lime or quicklime may be added to the water with which the arsenate of lead is mixed prior to combining with the lime-sulphur.

Scale insects : Emulsified red oil, to be applied at 1–10 during dry hot weather prior to bud-movement.

Red mite : Addition of nicotine or Black Leaf 40 to lime-sulphur, arsenate of lead, or soapy solutions. Emulsified oils, white summer 1–60, or winter oil 1–150.

Miscellaneous.

Recent research work has established a very definite relation between size of fruit, growth of tree, and quantity of foliage. To summarize the position, it may be stated it has been found that ten good leaves per individual fruit is sufficient to develop fruit of good marketable size, twenty to thirty leaves per fruit being essential for its development to the best commercial size. It has also been shown that the development of fruit-buds is below normal where less foliage than that stated is produced on the tree. Where development of foliage is below the

standards suggested as essential recourse should be made to manures rich in nitrogen, such as nitrate of soda or sulphate of ammonia.

When the branches of certain free-bearing varieties of apples, such as Jonathan and Sturmer Pippin, become opened out into more or less horizontal positions, the leaders should be raised and supported into more vertical positions, and maintained so, otherwise the sap bundles or vessels become compressed where the angle takes place, resulting in the retarding of the free circulation of sap necessary to maintain vigorous growth of wood and foliage. This condition also makes more difficult the process of stimulation with nitrogenous manures.

In September a commencement should be made to form sufficient mulch on the top-soil to conserve the moisture during the summer months.

—M. Davey, Orchard Instructor, Mapua, Nelson.

Citrus Culture.

The planting season is now approaching, and where new plantations are being laid down a good deal of preliminary work should have already been carried out. This was referred to in the April number of the *Journal*. If such matters as the placing of orders for the trees, selection of the most suitable site, making provision for shelter, and breaking-up of the land have not been attended to, then the most important foundation work has been neglected. Where such matters have received attention it will be necessary to take the first opportunity of still further preparing the soil for the reception of the young trees. However, this should not be attempted if the soil is in a wet or sodden condition.

The land should again be turned over with the plough to a depth of 6 in. to 8 in. If the subsoil is of a retentive nature it should be broken up with a subsoil plough to a further depth of at least 6 in. A common mistake is digging out the holes with a spade and loosening up the subsoil in the holes only. This is very poor orchard practice, and unless the subsoil over the whole area is broken up it is not wise to break up that immediately below where the trees are to be planted, as it is likely to cause root trouble from the accumulation of water.

After the ploughing has been completed the land should be well worked with either disk harrows or cultivators of some kind in order to provide a fine tilth and facilitate planting-out of the trees. The small extra cost involved in preparing the land as indicated is more than counter-balanced by the extra returns obtained from the trees in future years. It is far better to plant out a small area that will become 100 per cent. efficient than a larger area that only becomes from 50 up to 75 per cent. efficient. The difference between success and failure is to be found in the relative number of units that give the maximum or minimum returns in any given orchard. Assuming that it takes 75 per cent. of the trees in any given orchard to yield the maximum return to make it a commercial success, then it must be obvious that every tree under the 75 per cent. becomes a distinct loss, while every tree above this percentage gives a profit.

When the land is ready for planting and the soil is in a fit condition the work can be proceeded with during the next two months. The soil round the roots should be trodden firmly, and after the first tramping a little superphosphate or blood-and-bone should be sprinkled round the outside of the hole, and the filling can then be completed in the usual manner. If planting of the young trees is carried out as outlined, they will come away quickly and become well established.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Artificial Incubation.

MANY difficulties are being experienced by poultry-keepers at the present time, and some of these are so common that it is well to deal with them here.

The common cause of deformed chicks being hatched in an incubator is the lack of moisture, resulting in the air-cell drying down too far. This condition means that the membrane (or the skin on the inside of the shell) becomes so tough that the chick cannot pierce it. The constant working in the shell during the effort to get out, and being too long in the shell, injure the delicate legs of the little bird. To the observant person a chick thus affected will usually show an inflamed condition surrounding the hock joints and the feet for at least a day after being hatched, indicating that undue pressure was necessary during its final effort to break out of its shell.

Once a chick becomes affected in this way little or nothing can be done for it, as usually the limbs will become more and more deformed as the bird grows older, and therefore the wise course is to destroy it at the outset. The only satisfactory way of dealing with this trouble is to prevent it, and the great essential is to check, by the application of added moisture, the air-cell from drying down beyond a desired line. Even where chicks fail to hatch it will frequently be found on close examination that the hock joints are in a more or less inflamed condition through no other cause. Indeed, not only is the excessive drying-down of the air-cell a frequent cause of crippled chicks being produced, but it is probably more responsible for fully developed chicks dying in the shell at the pipping stage than any other cause.

The study of the air-cell is thus seen to be a matter of vital importance, for upon the operator knowing when added moisture is required depends largely the success or otherwise of the incubator work.

A common argument used against the drying-down of the air-cell being a guide to successful hatches is that at practically all stages of the incubation process eggs may be found in the same incubator with air-cells which vary considerably in size. This is quite true, but there is usually a cause which does not prove the air-cell theory to be wrong. For example, odd birds will sometimes produce eggs with thin, porous shells, and these will evaporate more rapidly than those with good-quality shells; hence a uniform air-cell cannot be secured. The placing of washed and unwashed eggs in the same incubator is another cause of uneven air-cells. The washed egg, whether inside or outside an incubator, always means a more rapid evaporation than the unwashed egg, and consequently a larger air-cell. The same applies where stale and fresh eggs are set together, as obviously the older the egg the larger will be the air-cell. Again, where brown- and white-shelled eggs are placed in the same machine, the former, being thicker in the shell, will be slower in their evaporation.

It will thus be seen that if best results are to be obtained from incubators special care should be taken to select eggs as far as possible of uniform colour, size, age, and quality of shell, while on no account should eggs intended for incubation be subjected to washing, unless, of course, they are decidedly dirty, and even then better results will be obtained if any adherent matter is scraped off the shell. Where washed and unwashed eggs or those of different ages are used in the same incubator, a more uniform air-cell can be struck by placing moisture in the machine for the first three or four days. It will generally be found that if the air-cell dries down in accordance with the usual book instructions, the desired moisture is being obtained.

Drying-down after Incubation.

It is generally accepted that artificially hatched chicks should not be moved from the incubator to the brooder for at least twenty-four hours after hatching, for the reason that if the chicks are transferred before they are thoroughly dried off they are highly susceptible to chill. While some poultry-keepers adhere closely to this rule, they make the mistake of not drawing away the water in the moisture-pan which is supplied with most incubators. Very often added moisture, especially during dry weather, is essential in assisting the hatching process, but it is of no use whatever after it has served this purpose. As soon as the hatch is cleaned up all moisture should be withdrawn, for obviously the chicks will not thoroughly dry down if compelled to remain in a humid atmosphere.

As a further means of assisting the drying-down process the ventilators should be opened wide, while it is also a good plan to open the incubator-door, say, about ⅛ in. for an hour or so before the chicks are removed to the brooder. Special care should be taken to arrange the door in such a way that it will not fall downwards, or serious trouble may result.

Non-absorption of Yolk in Chicks.

Failure to absorb the yolk of the egg, which is drawn into the body of the chick just before it leaves the shell, is a common cause of mortality during the brooder stage. It is generally believed that failure of the yolk to digest is due to feeding the chicks too soon after hatching, or to over-feeding during the first week. It is also considered by many keepers that breeding from overfat hens is responsible.

These factors may have some influence in regard to this condition of the yolk, but experience goes to show that it is due more to improper incubation than to any other cause. This is borne out to a great extent by the fact that the trouble is seldom found in chicks that have been hatched by the natural mother, in which cases it will be observed that the yolk in its sac is in a more or less liquid state, which enables it to run freely and finally to become absorbed. With incubator-hatched chicks the chief weakness probably lies in having the temperature too high during the whole or part of the incubating period, thus causing half-baking of the yolk and rendering it incapable of absorption. If such trouble is to be minimized it is of the first importance that every care should be taken to prevent an excessive degree of temperature in the incubator.

Green Feed.

In these days of high-priced foodstuffs the importance of losing no time in making every possible provision for the growing of ample green feed cannot be too strongly emphasized. No flock can possibly thrive without it, and this applies particularly to growing chickens. An abundance of green feed not only greatly assists in keeping the birds in a healthy state, but it also reduces the grain account. Furthermore, it tends to give the egg-yolk the desired rich colour. It is common for both growing and adult stock to go off their grain ration when hot weather conditions prevail, but rarely, if ever, will they refuse succulent green material.

Where possible, a variety of green feed should be provided, as birds of all ages are apt to tire of any one particular kind when a surfeit is fed. I have seen flocks of poultry absolutely refuse to eat silver-beet, as they had received nothing else as green food for months previously. Finely chopped succulent grass, lucerne, clover, and green oats are ideal green food for poultry, while any of the brassicas (cabbage family), lettuce, or silver-beet, will be much relished. Where watercress is available it is outstanding for poultry.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Starting Beekeeping : Hints for Beginners.

THE spring is the best season of the year for starting beekeeping, especially for the beginner who is unacquainted with the practical care of bees. The time is therefore at hand when arrangements should be made for the purchase of bees and equipment.

If the bees are obtainable locally the prospective beekeeper can make arrangements for the purchase of established colonies, or he can wait until swarming-time when swarms are available. Perhaps the most satisfactory way is to purchase some established colonies from a neighbouring beekeeper and move them home before too much brood is present in the hives. No harm will come to bees moved in the colder months, the provision for screening not being so essential as when moved during the summer months. Screening the hives top and bottom is not necessary if the bees are moved only a short distance, and if the precaution is taken of tacking a piece of wire gauze across the front entrance this will prevent suffocation and make for safe handling in transit.

The beginner will be well advised to procure only strong healthy colonies from a reliable beekeeper who can furnish a guarantee that the bees are healthy. Upon this depends much of his future success. The keystone to this condition is the permit issued by an Apiary Inspector under the Apiaries Act. The first question to be asked by the beginner of the seller is, " Have you the necessary permit to sell ? " If this is forthcoming he may rest assured that he has a reasonable chance of getting clean bees, apart from any of the other conditions which go to make a good hive. Although the purchase of first-class colonies is probably the most expensive way to commence beekeeping, they have the advantage that they are more easily kept in order than colonies which have been neglected and which require to have corrected the faults of the previous owner who has not learned to make his beekeeping profitable.

Since it cannot be expected that the beginner should know what constitutes a good colony, he should only deal with a beekeeper of some standing. Everything with bees depends upon starting right. The possession of a colony in prime working-condition gives the beekeeper a standard with which to compare other colonies, and enables him to avoid costly mistakes in their management. If the cost of starting a small apiary has to be considered the beginner will find it an advantage to arrange for the purchase of as many first swarms as are wanted. These may be obtained in boxes and subsequently transferred to frame hives. Only early and prime swarms should be stipulated for, otherwise they will not build up in time for a crop.

The hives when placed in their permanent position should be sheltered and face the north. Protection from cold winds is important, but the hives should not be placed under trees, as this has a tendency to make the bees vicious. The hives should be set on four bricks, allowing for a free circulation of air under the bottom-boards, which will rot if placed directly on the ground. The hives require to be level crosswise and have a slight cant to the front lengthwise. This prevents driving rains from lodging within the hives, which is likely to render the combs mouldy. A watertight roof and sound bottom-board are just as essential to the welfare of bees as are good floors and roofs in human dwellings.

A certain amount of working equipment is necessary. However, if provision is made for a smoker, bee-veil, hive-tool, and a pair of gloves, such other articles can be added as they are needed. Until such time as the beginner has got used to the stings he will find it an advantage to wear gloves, although he should accustom himself to do without them. In

the course of time gloves become impregnated with poison, and this will irritate one's skin on hot days; moreover, it is resented by the bees. There is much difference in the temper of bees, Blacks being much more troublesome to handle than Italians; but with a little care in carrying out hive manipulations and the free use of smoke most colonies can be handled with very few stings.

At all times when handling bees the beginner should be prepared to complete the work and not allow himself to be driven from the hives. "The free use of smoke" does not mean that the bees should receive an overdose, as this may demoralize them and render them liable to attack from other colonies. Moreover, it does not bring them under control, but tends to aggravate them. It has the further disadvantage that as the bees are driven from the combs they form in clusters on the bottoms of the frames and the sides of the hives, making it well nigh impossible to locate the queen and to carry out other essential work with any degree of success.

The best fuel for the smoker is dry, clean sacking, no other material being as good. Avoid oily waste and cotton materials, as the smoke from these articles makes the bees vicious. When starting to manipulate a hive puff a little smoke in at the entrance, and, having removed the roof, puff a little more on the frames as the mat is peeled off. This operation being complete, the frame nearest to the operator can be taken out, allowing of the prizing-apart of the remainder of the frames preparatory to making a complete examination of the whole. When handling bees all operations are best carried out in a gentle manner, avoiding at all times quick movements and clumsy manipulations which may crush them. It must be remembered that nothing irritates bees more than the odour of the poison which fills the air when bees are crushed.

During the warm days of early spring beginners who are anxious to look inside their hives may do so. Once the early nectar-secreting flowers show up hives may be opened and the combs examined without injury to the bees. In the event of a more critical examination being made, care should be exercised not to expose combs containing brood. On removing combs from the centre of the colony its condition will be revealed. Usually in the upper corners of the comb will be found capped honey—that is, if the colony is well supplied with stores. In the centre of the combs, providing the colony is queen-right, capped brood should be present, and adjoining the capped brood will usually be found cells of open brood ready to be sealed, larvæ in various stages, and finally eggs.

Stores of pollen stacked in cells between the brood and honey will also be noticed. The pollen is easily distinguished, packed as it is in solid masses and of various colours, depending upon the flowers from which it is gathered. By observing the bees at the entrance to the hives, they may be seen entering with little balls of pollen attached to their legs, and a close study of the colour and the flowers upon which the bees are working will enable the beginner to distinguish the various sources from which it is gathered. Pollen is used in large quantities during the breeding-season by the nurse bees in elaborating the food for the young. Fortunately there are few districts in New Zealand where supplies of pollen are not available in the spring, as most of the early-flowering native trees yield sufficient for a colony's needs. In the more settled districts gorse is valuable as a yielder of pollen, but it is of little value as a nectar plant.

By noting the size of the open cells the beginner will realize that some are larger than others. The larger cells usually found in the lower corners of the frame are drone cells, and it is in these that the drones are reared. In the warmer parts of the Dominion drones are already in evidence, and the writer observed quite a number in hives in the North Auckland

district last May. When the cells containing drone-brood are capped the cappings project, resembling the end of rifle bullets, being altogether different from the cappings over worker-brood.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

An Insect Pest of the Raspberry.

THE caterpillar larvæ of the *Carposina adreptella* moth has been very busy destroying the buds on new canes in many raspberry plantations during the past autumn. Specimen canes have been received during the winter months with most of the buds eaten out. The wood, apparently, is not to their taste, as attention is confined entirely to the widely spaced large dormant buds, which are eaten right out, and they are not renewed by the plant. As these buds normally push out and bear the fruit of the coming season, the serious loss of crop is readily imagined. Unable to bear a normal crop of fruit, the energies of the plant will be devoted to sending up a new crop of sucker canes. To save these from another serious attack from this insect pest is a problem the grower has to meet.

Although this insect is a native of the country, commonly attacking blackberry, we have little information regarding it beyond its identity. It appears to confine its attention to plants of the genus *Rubus*. Hudson states that the adult insect—that is, the moth—appears from September to March. Presumably the moth lays its eggs soon after emerging from the cocoon; the eggs hatch out in a few days, and the young caterpillars commence to feed immediately with their usual zest. If that is so, the crops are open to attack during the period of September to March inclusive.

For the first three months of this period the plants are in active growth, and the injury is not so mortal as that inflicted during the autumn, when, the dormant season approaching, growth ceases. Insect pests which feed on plants during the dormant period are always specially destructive. The damage to the specimen canes sent in during the winter must all have been done since the month of December, when the new canes were practically just appearing through the soil.

This pest is widely distributed, and the present severe attack is a reminder that it is not to be regarded lightly. It provides another reason why arsenate-of-lead insecticide should be added to the bordeaux-mixture spray which is applied during the spring on the old canes, and in autumn on the new ones after pruning, to protect them from fungus attacks. 1½ lb. of arsenate of lead in paste form, or ¾ lb. if used as a dry powder, should be carefully dissolved in a little water, then diluted further before stirring it into 50 gallons of bordeaux. To 4 gallons of bordeaux 2 oz. of paste or 1 oz. of powder will be a sufficient dose if it is well dissolved and then diluted before stirring it into the fungicide. Spraying should be done from the top downwards in a manner that will cover well the buds and angles in which they are placed.

The Tomato Crops.

The tomato crop will now be growing under glass—in houses for early cropping, and in frames for planting out in the months of October or November, according to the local climatic conditions and market demand. A successful tomato crop depends very much on the way it is managed during the changeable spring weather. During the summer, when the weather is warmer and the plants well established, they require com-

paratively little attention if plenty of air is then admitted to the house in which they are growing. Any mistakes in watering or ventilation now, however, quickly do damage that is almost irreparable. While stunting plants by chilling them should be avoided, it is almost as bad to grow coarse, sappy plants by keeping them too warm and moist. Thrifty growth, plenty of blossom, and a rather dry, buoyant atmosphere are what should be looked for at the present time where this crop is growing under glass.

For young plants now growing in frames for planting out later the period is also critical. Sturdy, clean plants may be grown now by giving tepid water sparingly and airing the plants promptly in warm, sunny weather. Damping-off disease and crown-canker are the commonest penalties for mismanagement at the present time. The worst feature in these attacks is that many of the affected plants are not noticed until they have been planted out in the field some time and the disease has made some progress. Replacements have to be made, and an uneven crop is one of the results.

Land on which the tomato crop is to be grown outside should be ploughed so soon as the previous crop is harvested. A good application of bonedust before ploughing and a dressing of lime harrowed in afterwards is suitable treatment in many instances.

Other Half-hardy Fruits.

Egg-plants and chillies are other half-hardy fruits of this class which are becoming popular, and may now be sown for planting out later. Melons, cucumbers, and even marrow plants may be raised under glass now in pots for planting out in a rich, light, moist soil. An early crop of small marrows is a choice crop that is usually in good demand.

Vegetable Crops.

During the changeable weather usually experienced at this season it is important to take immediate advantage of the drier intervals to hoe growing crops recently established, also fallow land that has to be cleaned in preparation for another crop. Such periods are also valuable opportunities for sowing seeds. A small hand-drill does the work expeditiously and well. It should be carefully adjusted to sow the seed thinly, so that little or no thinning has to be done afterwards, a laborious operation that greatly increases costs. On heavy land especially great care is needed to work it only when it is dry, and in some seasons these opportunities are so rare as to delay the work seriously; but nothing is gained by breaking this important rule.

Plant now cauliflower, cabbage, and main-crop potatoes, and sow main-crop carrots, beet, peas, spinach, white turnips, and salads. It is usually advisable to group the early-maturing crops, so that they may be cleared in time for planting the land with the important winter crops during the months of December and January. In preparation for this planting, leeks and celery seed should be sown towards the end of the month. For such half-hardy crops as French and runner beans, marrows, and pumpkins, which are sown outside in the months of October and November, the preparation of the land should be undertaken as soon as it is available.

The Home Garden.

The successful home garden depends chiefly on a tasteful arrangement and the good health and fertility of the plants. This applies with equal force to the lawns, which can usually be greatly improved by giving them some attention now in addition to the usual mowing. Most lawns are much improved by applying a dressing of sulphate of ammonia two or three times at an interval of three or four weeks, commencing the treatment now.

The latest recommendation is to mix three parts sulphate of ammonia and one part sulphate of iron with twenty parts sand, break it down fine, mix it through a sieve, and apply 4 oz. per square yard. This will not only strengthen the grasses, but also destroy the weeds. Lawns on light land would be improved if they were rolled occasionally now with a roller of moderate weight. Combined with the fertilizing treatment before mentioned, this will go a long way towards preventing the attack and remedying the effects of grass-grub.

Another pest of lawns, especially when the ground is usually rather wet, is the earthworm. The casts from the burrows spoil the appearance of the lawn, and when numerous they are detrimental in other respects. The remedy for this condition is a solution of bluestone (sulphate of copper). Dissolve 1 lb. with hot water and dilute it up to 50 gallons. This should be applied to 100 square yards of lawn. The solution should be contained in vessels of wood, copper, glass, or stoneware, as tin or iron decompose the bluestone. Another important precaution is to apply the solution in dull weather when rain threatens, and more especially towards the end of an afternoon. Under such conditions the pest is near the surface and more readily destroyed.

Some of the choicer flowering shrubs are given special attention in the way of annual pruning. Trees and shrubs which flower on wood formed last season should have that growth cut back, after flowering, to the buds at its base. This treatment encourages the development of the new wood for flowering next year. Heaths, forsythias, diervillas, deutzias, philadelphus, rambler rose, lilacs, &c., are of this kind. The work should be done so soon as the flowering period is over.

Another seasonable operation at the present time is to repot such house plants as require it. If the pots are filled with roots and more growth is desirable, it may be obtained by shifting the plants into larger pots. Many plants may be divided, potted up, and so increased. Or the top soil may be removed and replaced with fresh and richer soil. In doing this it is important to make up a suitable mixture; it should be composed of a good fresh fibrous loam that is rich and in good condition, sand to keep it open, and humus (preferably in the form of leaf-mould) to enrich it and give those qualities which enable the mixture to retain moisture, without which no plants can make much growth. A little bone-dust, old soot, and wood ashes will also often be beneficial. Water the plants well shortly before the operation, pot them up firmly, and water very cautiously afterwards until they are well established.

—W. C. Hyde, Horticulturist, Wellington.

The Alien Flora of New Zealand.—Referring to Dr. H. H. Allan's article on this subject in the *Journal* for June last, it has been found necessary, owing to pressure on space by matter of more immediate concern, to defer indefinitely the publication in the *Journal* of the proposed lists of alien plant species.

Current Horticultural Literature.—We have received the first number of *Horticultural Abstracts*, issued by the Imperial Bureau of Fruit Production, East Malling, Kent, England. This publication has arisen in response to the express desire of horticulturists from all parts of the Empire, culminating in a resolution adopted at the First Imperial Horticultural Conference held in London, August, 1930. Its aim is to collect under one cover summaries of the more important current horticultural literature, special emphasis being attached to fruit-production, storage, and allied subjects. These summaries will be of sufficient length to indicate the contents and scope of the papers concerned. Each volume will consist of four parts, which it is proposed to issue quarterly. Price, 1s. 6d. per number, or 5s. yearly, post-free.

CERTIFICATION OF SEED POTATOES.

CROPS PASSED TUBER INSPECTION TO 31ST JULY, 1931.

FOLLOWING is a list of growers whose crops have been subjected to and have passed the tuber inspection in connection with the system of Government certification of seed potatoes conducted by the Department of Agriculture. The list comprises those crops passed up to 31st July; further lists will be published later.

In the June *Journal* was published a list of growers who had received provisional certificates. The acreage, cropping-power, and percentage of foreign varieties present were given in that list, to which intending purchasers should refer.

Aucklander Short-top (N.Z. Sutton's Supreme).

W. Oakley, R.M.D., Halkett.
H. A. Hancock, Awahuri, Palmerston North.
R. S. Roper, R.M.D., Halkett.
J. Petrie, jun. (Line D), Swannanoa.
A. J. Rich, R.M.D., Kaiapoi.
R. Barnett (Line A), Dunsandel.
J. Petrie, jun. (Line A), Swannanoa.
W. E. Martin (Line A), R.M.D., Kaiapoi.
J. Warren (Line B), 149 Russley Road, Fendalton.
M. Breen, Levels.
A. F. Brown (Line B), Woolridge Road, Harewood.
Gardiner Bros., Upper Waitohi, via Temuka.
J. W. Ferguson, Upper Winchmore, Methven.
C. Redmond (Line B), Kimberley.
H. Shea, Makikihi.
W. T. Sings, Seedsman, Oamaru.
G. Gudex, Levels.

Aucklander Tall-top (N.Z. Sutton's Supreme).

J. Warren, 149 Russley Road, Fendalton.
H. S. Moore, Box 4, Kaiapoi.
Hampton Bros., Pareora, via Timaru.
D. Hewitt, Woodend.

Dakota.

G. Gudex, Levels.
H. Smythe, care of G. G. Wanson, Darfield.
R. Barnett, Dunsandel.
W. McPhail, jun., Mitcham.

Bresee's Prolific.

D. Marshall, R.M.D., Leeston.
A. Allen, Killinchy.

King Edward.

Gore Experimental Area, Gore.
J. L. Caulfield, Glencoe R.M.D., Invercargill.
L. A. King, Glencoe R.M.D., Invercargill.
D. Burgess, West Plains, Invercargill.
A. H. Rose, Forest Hill, Invercargill-Glencoe R.D.

Epicure.

G. McLachlan, R.M.D., Southbridge.
D. Marshall, R.M.D., Leeston.

Majestic.

R. Borthwick, Darfield.

Early Regent.

J. Curragh, Templeton.

Early Rose.

R. G. Robinson, 12 North Road, Papanui, Christchurch.

Robin Adair.

D. Marshall, Leeston.

Arran Chief.

L. T. Wright, Annat.

Field Marshal.

L. T. Wright, Annat.

—*Fields Division.*

Harvesting Brown-top Seed.—The Instructor in Agriculture, Invercargill, reports that in the past season one of the big brown-top growers in the Wairo district adopted a different method of harvesting, with good results. He cuts with the mower, puts the cut grass into windrows with side-delivery tedder, sweeps into the mill with sweeps, and threshes right away. He reckons he is getting a cleaner thresh and does not miss or lose so much seed by this method.

WEATHER RECORDS: JULY, 1931.

Dominion Meteorological Office.

JULY will be remembered for several severe storms which were responsible for boisterous and prolonged westerly or south-westerly gales, and for heavy and widespread snowfalls. Heavier snow has been experienced in the North Island, but in the South it is many years since similar conditions have been reported. New Zealand is liable to occasional series of cold years, and it is generally in them that the most noteworthy snowfalls occur. Temperatures were below normal from 1877 to 1879 and from 1901 to 1906, and have been so, also, since the middle of 1929. 1877 and 1878 were years of record snowfall in some districts, and it is to those years that residents on the west coast of the South Island and in Southland, respectively, have to look back for falls comparable with that of the 19th to 20th July of this year. The years 1902 to 1904 were also periods of very heavy snow, especially in the interior of Canterbury and Otago, and the falls of last month were about equal to the heaviest in those years.

Severe frosts followed the snows in the South Island, but in the North Island conditions were, on the average, rather milder than usual.

Rainfall continues to be deficient in South Canterbury and Northern Otago, but in most other parts July was a very wet month. This was particularly the case in places which receive their rain mainly from the west. There, the persistent and almost daily rains kept the rivers high during the greater part of the time. Though the floods were nowhere severe, the Manawatu River eroded portion of its banks in the Foxton district, and much of the low-lying country was under water.

Stock and pastures are reported as generally in fair order, especially in the North Island, some growth of grass having taken place in most localities. The saturation of the soil by continuous rains in Taranaki, and the snow and frosts in parts of the South Island, caused a slight deterioration in condition, especially of cattle.

Rainfall.—Isolated places in North Auckland and in South Westland experienced less than the average rain for July, as did also the central eastern portion of the South Island from Christchurch to Oamaru. Elsewhere, the normal was exceeded, and in most cases by large amounts.

Temperature.—Though temperatures were still generally below normal in the South Island, the departures were not so large as they have been in a number of recent months. In the far North the month was a fairly warm one, and though the normal was approached in the southern part, most of the North Island recorded temperatures slightly above it. This was due principally to the absence of low minimum temperatures. The South Island, on the other hand, while having some warm and sunny days, experienced frequent and severe frosts. A minimum temperature of 11·9° F. on the grass was observed at Christchurch on the morning of the 20th, which constitutes a record for that station. In parts of Otago, also, the frost was unprecedented.

Storm Systems.—The month opened with a spell of comparatively fine weather during which pressure was high to the north, while several westerly depressions of slight intensity passed in the south. On the 8th, however, a cyclone, which had been developing during the preceding two days on the coast of New South Wales, moved from the west towards the centre of the North Island. The centre passed during the night, but secondary centres developed behind it, the last not crossing the North Island until the 10th. During these three days rain was fairly general. The North Island, and especially the central districts, experienced very heavy falls. Many rivers in Nelson, Marlborough, and Wellington reached flood levels, but the rain was not sufficiently intense at any time to cause serious damage. There was heavy snow on the high levels in the South Island.

A second but shallower cyclone which crossed the South Island on the 14th brought rain again to much the same districts. This was followed by a rather vigorous depression of the westerly type on the 16th. After the main depression had passed, a severe spell of weather set in. Though barometers were high far to the west, they continued to fluctuate about very low values in Southern New Zealand. The wind chopped and changed between west and south-west. Snow

RAINFALL FOR JULY, 1931, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.
	North Island.	Inches.		Inches.	Inches.
1	Kaitaia	5·03	22	0·87	5·92
2	Russell	6·72	14	1·72	5·28
3	Whangarei	5·87	20	2·02	7·47
4	Auckland	7·01	26	1·43	5·06
5	Hamilton	6·98	23	1·02	5·10
6	Rotorua	5·51	17	1·09	5·09
7	Kawhia	7·01	20	0·95	6·22
8	New Plymouth	8·93	27	1·67	6·38
9	Riversdale, Inglewood ..	16·31	28	2·51	10·16
10	Whangamomona	13·40	22	2·23	7·35
11	Eltham	10·97	27	2·53	5·98
12	Tairua	10·24	19	2·70	6·25
13	Tauranga	6·23	22	1·30	5·07
14	Maraehako Station, Opotiki	7·94	20	2·62	4·54
15	Gisborne	5·21	12	2·10	5·08
16	Taupo	5·11	20	0·86	3·94
17	Napier	4·00	14	1·83	3·81
18	Hastings	5·44	16	1·85	3·66
19	Taihape	5·01	25	0·69	2·93
20	Masterton	6·08	19	1·48	4·19
21	Patea	10·47	27	4·25	4·17
22	Wanganui	5·04	22	0·98	3·39
23	Foxton	4·40	18	1·04	3·24
24	Wellington	5·39	19	1·87	4·71
	South Island.				
25	Westport	13·03	23	2·62	8·30
26	Greymouth	11·56	22	1·86	8·03
27	Hokitika	10·91	23	1·56	8·91
28	Ross	11·18	21	2·06	9·62
29	Arthur's Pass	..	..	..	11·06
30	Okuru	4·94	14	1·08	11·14
31	Collingwood	14·64	18	3·04	9·56
32	Nelson	3·63	13	1·27	3·59
33	Spring Creek	4·86	15	1·80	3·62
34	Tophouse	10·39	21	1·20	4·89
35	Hanmer Springs	5·25	16	0·73	4·38
36	Highfield, Waiau	4·51	8	2·24	3·35
37	Gore Bay	4·00	12	1·47	2·78
38	Christchurch	2·07	12	0·69	2·70
39	Timaru	0·44	9	0·20	1·98
40	Lambrook Station, Fairlie ..	0·95	7	0·26	2·74
41	Benmore Station, Clearburn	0·91	11	0·20	1·70
42	Oamaru	0·40	7	0·12	1·79
43	Queenstown	4·01	13	0·85	2·04
44	Clyde	1·33	9	0·31	0·93
45	Dunedin	1·91	20	0·40	3·07
46	Wendon	2·34	12	0·43	1·76
47	Gore	..	..	..	1·96
48	Invercargill	6·12	23	1·00	3·21
49	Puysegur Point	9·18	26	0·97	6·08
50	Half-moon Bay	9·48	22	1·36	4·12

fell on all the high levels, and in the South Island was almost general. Many places had the heaviest fall on the 19th to 20th for the past thirty to fifty years. Severe hailstorms also were experienced. The hail and snowstorms were preceded on the night of the 18th by a very violent and unusually widespread westerly gale. It was not until the 21st that conditions began to improve, and even on that day some of the central districts of the North Island had snow.

Between the 23rd and the 25th a cyclone, which became very deep, crossed North Auckland in the neighbourhood of Russell, and moved in an east-south-east direction. Its passage was accompanied by rain, which, however, failed to reach the southern and western portions of the South Island. In the North there were some heavy falls. North-easterly gales blew from Auckland northwards as the cyclone approached, while in its rear there were southerly gales.

From the 27th to the end of the month occurred a similar spell of weather to that between the 16th and 21st. Following a series of westerly depressions, pressure again became high to the west and north-west, while fluctuating about very low levels to the south and south-east. South-westerly gales blew continuously in the eastern portion of the Tasman Sea for several days from the 30th onwards, rising to unusual violence. Districts with a westerly aspect experienced persistent rain. Snow again fell on the high levels for several days consecutively, but the low levels were little affected.

—Edward Kidson, Director of Meteorological Services, Wellington, 6th August, 1931.

AMENDING REGULATIONS UNDER THE DAIRY INDUSTRY ACT.

A NUMBER of amendments to the Dairy Regulations were gazetted on 30th July, and came into force on 1st August. Following is a brief summary of the more important of the new regulations :—

(1) The manufacture and export of other than whole-milk cheese is prohibited.

(2) The occupier of a dairy is required to provide an adequate water-supply and plant adjacent to his dairy for the purpose of washing and scalding or steaming his dairy utensils. In addition, all milk-cans which have been used to convey hot water or whey from the dairy factory must be similarly treated on arrival at the dairy-farm.

(3) Milk must be so cooled on the farm premises that its temperature on arrival at the dairy factory does not exceed 70° F.

(4) All cheese manufactured during the months of August and September must be kept on the shelves for twenty-one days before being packed, and each cheese must be turned once a day. The temperature of the curing-room containing any cheese which is to leave the dairy factory within one month of manufacture must be maintained at not less than 55° F.

(5) The temperature of cheese in grading-stores is to be not less than 50° F. or more than 55° F.

(6) In the case of the South Island the period during which the testing of milk samples at intervals not exceeding twelve days is not required by the regulations has been extended to the months of May to September in each year.

Protection of Ferrets, Stoats, and Weasels.—The general protection conferred on these animals under the Rabbit Nuisance Act has been removed in the case of all areas of land in New Zealand of 10 acres or more in natural forest. This measure has been taken in the interests of bird preservation.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

PIG WITH PROTRUDING RECTUM.

"DAIRYMAN," Oxford :—

I have a pig, a weaner about nine weeks old, with a protruding bowel. I tried to return the bowel, but was not successful. Is there anything to be done?

The Live-stock Division :—

Protrusion of the rectum in young pigs is usually associated with an ill-balanced ration. A pig's diet should contain substances to assist in bone-making, and contain also a reasonable amount of protein. Skim-milk, supplemented with pollard and grain, is usually fed, but where the supply of skim-milk is limited meat-meal forms a very valuable ration for young pigs. Four ounces of meat-meal should be given when the piglets are eight weeks old, gradually increasing the amount, so that at the age of twelve weeks each pig is receiving 8 oz. of meat-meal. Mangels fed in conjunction with meat-meal have given excellent results. If pigs are fed in this way such trouble as protrusion of the rectum should cease. Generally when the protrusion is pushed back it comes out again, but if the animal is valuable a surgical operation can be performed by a veterinary surgeon.

WALNUT TREES.

"INQUIRER," Temuka :—

I should be pleased if you could advise me the best variety of walnut tree for South Canterbury. Any particulars as to soil requirements would also be appreciated.

The Horticulture Division :—

The different kinds of walnuts usually stocked by nurserymen here are the Japanese, English, and large French. The first-mentioned makes a very ornamental shade tree, and the French nut is very large; but the English walnuts are best for dessert purposes, and they are those generally seen in commerce. The most suitable soil is a good alluvial loam with an open subsoil.

MAKING A MANUKA DRAIN.

E. A. M. LYS, Mangatoro, Dannevirke :—

I intend making a covered drain, using manuka. Will you be good enough to reply to the following questions: (1) Should the trench that receives the manuka be V-shaped, so that the manuka does not go quite to the bottom but allows a free passage for water? (2) What is the minimum thickness the manuka requires to be? (3) Would it be better to cut the top or brush of the manuka off, only using the stem? (4) In what order should the subsoil (clay), soil, and sods be replaced on filling in? Please state any other points which would be of importance in constructing this drain.

The Fields Division :—

Taking your questions seriatim—(1) Such a method is not common practice. There is no objection to a slight batter, but it will be understood that if manuka is placed in a V-shaped drain the pressure from weight of soil above in the settling-down process has a tendency to compress the manuka unduly into the V-shaped space below and defeat the object in view.

(2) This may involve such considerations as the flow of water it is intended to deal with, and the amount and quality of manuka available, &c. The length of drain or quantity of flow governs the thickness of the manuka layer, just as

in the case of tile-draining a larger tile becomes necessary; also whether the stems of the manuka are light or heavy and their proportion to brush is large or small. In regulating the thickness of the layer it can be estimated with average material that it will subsequently be compressed to approximately one-third of its original bulk. It will thus be seen that the layer may vary all the way from 1 ft. to 2 ft., according to circumstances; but it is always advisable to err on the safe side, provided the material is available.

(3) This is not advisable when it is understood how the manuka should be placed in the trench. The manuka should be laid with a slight slant, so that the points of the stems only are on the bottom of the trench and the brush ends are lying in a thatching manner above the previously placed material. Thus the heaviest portions are in the bottom and provide better percolation, while the brush ends on top prevent the covering soil from working downwards. If the thickness of the manuka layer is to be greater the slant at which it is laid will be greater, and the reverse if only a thin layer is required.

(4) In the case of all covered drains fill in the sods immediately on top of the drainage-material, and the remaining loose material last. Such a method assists percolation and the better working of the drains.

MOULD FROM PINE-NEEDLES.

J. H. KIDD, Greytown :—

Is leaf-mould from pine-needles of value as garden top-dressing? There seems to be a rather general opinion to the contrary.

The Horticulture Division :—

A deposit of pine-needles over a period is of value in the reclamation of sand-dunes and similar waste land by the formation of a mould on which grass can be established; but the chemical composition of pine-needles is such as to render them of very low quality as a leaf-mould or top-dressing medium as compared with most other decayed vegetable matter. The resin in pine waste appears to make it objectionable to other plants.

FERTILIZER IMPORTATIONS: JUNE QUARTER.

FOLLOWING are particulars of importations of fertilizers into New Zealand for the quarter ended 30th June, 1931 :—

Sulphate of ammonia: United Kingdom, 825 tons. *Basic slag:* United Kingdom, 6,345 tons; Belgium, 19,497 tons; France, 75 tons. *Bonedust:* India, 60 tons. *Guano:* United Kingdom, 8 tons. *Rock phosphate:* Ocean Island, 22,745 tons; Nauru Island, 4,711 tons; Tuamotu Archipelago, 2,886 tons. *Superphosphate:* Germany, 100 tons; Netherlands, 100 tons. *Phosphates (other):* Belgium, 2,255 tons; France, 25 tons; Netherlands, 800 tons. *Kainit:* France, 10 tons; Germany, 45 tons. *Sulphate of potash:* France, 96 tons; Germany, 75 tons. *Potash (other):* France, 285 tons; Germany, 614 tons. *Sulphate of iron:* United Kingdom, 8 tons. *Other fertilizers:* United Kingdom, 2 cwt.

Index Numbers of Prices of Agricultural Products.—The International Institute of Agriculture, Rome, has recently published a methodological study having the object of explaining the purposes and procedures adopted in many countries in the construction of the different series of index numbers, and therefore their significance. This documentation has a scientific and practical interest for all those occupied in the study of agricultural economics. This publication also contains tables in which are grouped all the data available for a series of years, as far as possible, from January, 1921, to December, 1929, concerning index numbers of prices of agricultural products and other price-indices of interest to the farmer. The Institute publishes periodically in its *Monthly Crop Report and Agricultural Statistics* the index numbers which are available in many countries of the world.

EXPORTS FROM NEW ZEALAND FOR YEARS ENDED 30th JUNE, 1930 AND 1931.

Commodity.	Unit.	Quantity.		Value.	
		1929–30.	1930–31.	1929–30.	1930–31.
New Zealand Products.				£	£
Butter	Cwt.	1,817,799	1,808,232	13,022,957	9,918,260
Casein	,,	65,928	61,568	192,558	99,005
Cheese	,,	1,675,906	1,789,871	6,361,329	5,226,600
Fish	,,	22,766	19,227	79,974	56,525
Honey	lb.	607,581	356,476	20,772	11,852
Beef, frozen	Cwt.	328,474	280,929	577,120	384,419
Lamb, frozen	,,	2,014,702	2,300,817	6,884,717	6,523,543
Mutton, frozen	,,	1,021,146	1,188,100	2,042,301	1,810,766
Pork, frozen	,,	132,730	136,005	467,475	382,844
Other frozen meats	,,	150,483	160,976	281,282	320,083
Beef, salted	,,	2,442	1,986	6,630	5,163
Meats, potted and preserved	,,	31,758	37,481	143,277	134,919
Sausage-casings	lb.	4,200,707	3,846,880	779,651	500,535
Milk, preserved	,,	2,621,990	1,053,265	56,864	23,061
Milk, dried	,,	10,746,152	13,653,467	285,837	290,116
Peas	Cental	153,311	87,734	101,700	61,061
Oats	,,	4,569	1,756	2,323	1,111
Apples, fresh	lb.	56,211,770	52,599,514	724,595	649,799
Hops	,,	314,681	197,712	16,235	8,207
Potatoes	Ton	1,596	906	13,007	6,440
Live-stock	..	..	..	121,267	61,061
Calf-skins	Number	649,783	676,683	201,298	163,567
Hides, horse and cattle	,,	273,914	306,583	374,646	298,166
Rabbit-skins	,,	8,257,869	6,736,761	315,198	130,251
Opossum-skins	,,	156,675	96,195	102,461	29,429
Sheep-skins, with wool	,,	1,207,604	1,603,547	333,515	234,818
Sheep-skins, without wool	,,	9,762,632	8,397,075	1,336,524	647,898
Wool	Bale	553,298	648,630	8,156,309	6,195,127
Phormium fibre	Ton	10,245	3,263	273,778	65,724
Seeds, grass and clover	Cwt.	43,955	44,585	167,781	186,494
Tallow	Ton	22,118	23,861	686,261	505,979
Coal	,,	157,430	81,095	215,568	131,290
Kauri-gum	,,	4,891	2,622	257,964	124,168
Gold	Ounces	132,313	126,816	544,999	519,795
Silver	,,	512,148	512,949	46,110	33,840
Leather	..	..	..	8,722	7,607
Timber, sawn	Sup. ft.	38,255,654	16,827,136	426,505	188,684
Other products	..	..	..	593,547	337,476
Total	..	..	..	46,223,057	36,275,683
Re-exports	..	..	..	1,365,156	669,294
Total exports	..	..	..	47,588,213	36,944,977

The item "Other products" in the above table includes the following for the year 1930–31: Bacon and hams, 123,879 lb., £6,032; meat-extract, 95,213 lb., £15,254; pears, 1,698,484 lb., £28,087; onions, 90 tons, £849; tow, 816 tons, £10,909; linseed, 1,636 cwt., £1,185; neatsfoot-oil, 19,919 gallons, £3,166; fungus, 1,772 cwt., £10,531; gelatine, 33,700 lb., £1,685; eggs, 1,581 doz., £142; hair, 779 cwt., £3,185; seeds, other (including vegetable and flower), £3,279.

GRADINGS OF BUTTER AND CHEESE, YEAR 1930-31.

THE Dominion quantities of butter and cheese graded for export by the Dairy Division during the twelve months ended 31st July, 1931 (the dairy industry year), were as follows :—

Butter : Salted, 93,425 tons ; unsalted, 3,606 tons : total, 97,031 tons—an increase of 1·76 per cent. compared with the figures for the preceding twelve months.

Cheese : White, 59,904 tons ; coloured, 29,325 tons : total, 89,229 tons—an increase of 2·26 per cent.

In butterfat equivalent the amounts for butter and cheese combined represent a net increase of 2·5 per cent. compared with those for 1929–30, hitherto the peak year. A new high-level record in annual butterfat-production has thus been established.

THRESHING RETURNS OF WHEAT AND OATS.

TABULATED below are particulars of threshings of the past season's wheat and oat crops, covering the period January–June, 1931, compiled by the Census and Statistics Office from returns received up to 20th July :—

Land District.	Wheat.					
	Firsts.			Seconds.	Total threshed.	Average Yield per Acre.
	Tuscan or Longberry.	Hunters (Varieties).	Pearl or Velvet.			
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
Gisborne ..	830	..	..	52	882	51·88
Hawke's Bay ..	16,333	..	80	501	16,914	24·80
Taranaki ..	3,376	..	..	112	3,488	40·09
Wellington ..	105,873	15,393	5,335	4,969	131,570	43·14
Nelson	20,040	21,866	902	2,653	45,461	29·81
Marlborough ..	84,500	26,362	19,056	9,922	139,840	32·02
Canterbury ..	4,260,059	925,874	161,263	307,757	5,654,953	31·62
Otago	457,691	301,546	88,039	55,747	903,023	33·58
Southland ..	90,261	1,442	4,429	4,833	100,965	25·86
Totals ..	5,038,963	1,292,483	279,104	386,546	6,997,096	31·90

Land District.	Oats.					
	White.	Dun.	Black.	Algerian.	Total threshed.	Average Yield per Acre.
	Bushels.	Bushels.	Bushels	Bushels.	Bushels.	Bushels.
Gisborne ..	..	..	..	930	930	44·29
Hawke's Bay ..	1,787	..	..	7,378	9,256	32·82
Wellington ..	8,514	1,262	8,160	52,096	70,032	42·96
Nelson	765	1,830	..	12,648	15,243	33·87
Marlborough ..	3,411	..	1,984	35,264	40,659	40·12
Canterbury ..	819,342	197,286	30,801	347,255	1,394,684	37·94
Otago	616,792	53,786	40,079	44,886	755,543	48·51
Southland ..	800,779	46,524	8,303	..	855,606	50·81
Totals ..	2,251,481	300,688	89,327	500,457	3,141,953	43·31